ABSTRACTS OF NORTH AMERICAN GEOLOGY

June 1971

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

UNITED STATES GOVERNMENT PRINTING OFFICE, WASHINGTON : 1971

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June
1971

UNITED STATES DEPARTMENT OF THE INTERIOR

ROGERS C. B. MORTON, *Secretary*

GEOLOGICAL SURVEY

William T. Pecora, *Director*

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D. C. 20402. Price 75 cents (single copy). Subscription price: $9.00 a year (12 monthly issues); $2.25 additional for foreign mailing. Use of funds for printing this publication approved by the Director of the Bureau of the Budget (October 10, 1968). (exp. 12/71)

ABSTRACTS OF NORTH AMERICAN GEOLOGY

INTRODUCTION

Abstracts of North American Geology contains abstracts of technical papers and books and also citations of maps on the geology of North America including Greenland, the West Indies, as well as the State of Hawaii, Guam, and other island possessions of the United States. Articles of a general nature by North American authors are cited even though published in foreign journals, but those by foreign authors are included only if they appear in North American journals. Abstracts are prepared only of material that is believed to be generally available. Ordinarily abstracts are not published of material with small circulation (such as dissertations, open-file reports or memorandums) or of other papers presented orally at meetings.

The Abstracts is an additional reference tool but does not replace the Bibliography of North American Geology, which has been published by the Geological Survey since 1887. Twelve monthly issues of Abstracts of North American Geology are published each year. The Bibliography includes citations and subject index for a calendar year.

The numbers assigned to the abstracts in this publication are for reference in using the index; they are not order numbers. Publications cited here in abstract form are available in most geological libraries or through interlibrary loan.

Abstracts of North American Geology and the Bibliography are prepared by use of computer techniques. Each abstract, along with its indexing, is placed on magnetic tape and entered into a permanent data bank. The material prepared each month is published in the form of the present issue. The abstracts are arranged alphabetically according to senior author. A subject index follows the abstracts and is designed for rapid reference to any subject desired. Bibliographies can subsequently be retrieved according to the terms used in the index.

A list of journals commonly cited in Abstracts of North American Geology may be obtained by writing to the U.S. Geological Survey, Washington, D. C. 20242. Serial publications cited for the first time are as follows:

Acta Geog. Lodziensia—Acta Geographica Lodziensia. Łódzkie Towarzstwo Naukowe. Łódź, Poland.

Assoc. Française Gemmologie Bull.—Association Française de Gemmologie Bulletin. Paris, France.

Canada Natl. Mus. Nat. Sci. Pubs. Palaeontology—Canada National Museum of Natural Sciences Publications in Palaeontology. National Museums of Canada. Ottawa, Ontario, Canada.

[Great Britain] Inst. Geol. Sci. Geophys. Paper—Institute of Geological Sciences Geophysical Paper. Natural Environment Research Council. London, England.

Inst. British Geographers Spec. Pub.—Institute of British Geographers Special Publication. London, England.

Natl. Research Council Canada Pub.—National Research Council of Canada Publication. Ottawa, Ontario, Canada.

New Zealand Soc. Earthquake Eng. Bull.—Bulletin of the New Zealand Society for Earthquake Engineering. Wellington, New Zealand.

Pan American Inst. Geography and History Spec. Pub.—Pan American Institute of Geography and History Special Publication. Washington, D.C.

Smithsonian Contr. Earth Sci.—Smithsonian Contributions to Earth Sciences. Smithsonian Institution Press. Washington, D.C.

Washington Dept. Ecology Water-Supply Bull.—State of Washington Department of Ecology Water-Supply Bulletin. Olympia, Wash.

The abstracts in this issue were prepared by James W. Clarke, Georgianna D. Conant, John H. Feth, S. E. Frezon, Richard E. Grant, Elizabeth Hambleton, Anna Hietanen-Makela, John W. Huddle, Virginia M. Jussen, B. H. Kent, R. A. Loney, Elisabeth S. Loud, D. R. Mabey, Sergius H. Mamay, Mildred C. Mead, E. A. Merewether, Willis H. Nelson, Virginia S. Neuschel, James P. Owens, Earl H. Pampeyan, D. W. Rankin, John C. Reed, Jr., E. G. Sable, Vernon E. Swanson, Dorothy B. Vitaliano, Holly C. Wagner, and Ray E. Wilcox.

ABSTRACTS

Abbott, Agatin T. *See* Macdonald, Gordon A. 05856

Abdel-Gawad, M. *See* Housley, R. M. 06286

06038 **Adams, Herbert G.; Cohen, Lewis H.; Rosenfeld, John L.** Solid inclusion piezothermometry, experimental calibration of quartz-almandine and sillimanite-almandine [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 479, 1970.

Adams, John A. S. *See* Hartung, Jack B. 06393

06266 **Adams, John B.; McCord, Thomas B.** Remote sensing of lunar surface mineralogy — Implications from visible and near-infrared reflectivity of Apollo 11 samples, *in* Apollo 11 Lunar Sci. Conf., Houston, Tex., 1970, Proc. — V. 3, Physical properties: New York, and Oxford, England, Pergamon Press (Geochim. et Cosmochim. Acta Supp. 1), p. 1937-1942, illus., 1970.

The reflectivity curve for the Apollo 11 fines closely matches the telescopic curve for an 18 km diameter area that includes the landing site. A laboratory study of four lunar rocks and two samples of fines indicates that the shallow depression at 0.95 μm in the telescopic curve is a degraded band arising from electronic absorptions in clinopyroxene and to a minor extent in olivine. Iron- and titanium-rich glass in the lunar fines accounts for the strong blue absorption in the telescopic curve and may be primarily responsible for the low albedo. Bands at approximately 0.95 μm in telescopic curves for Kepler, Aristarchus and Plato C indicate the presence of clinopyroxene similar to that found at the Apollo 11 site. The curve for the lunar highlands has a very weak band, implying that clinopyroxene is less abundant there. Variations in the amount of dark glass are suggested by differences in curve slopes for diverse lunar maria areas. — Authors' abstract

06315 **Ahmad, Moid Uddin.** A hydrological approach to control acid mine pollution for Lake Hope: Ground Water, v 8, no. 6, p. 19-24, illus., 1970.

Acid mine drainage is a serious problem in the Appalachian region. Coal mining has disturbed the natural ground flow system. The mines are continuously being flushed by this disturbed flow system and producing an enormous quantity of sulfuric acid. A study of McDaniel Mine [Ohio] has revealed that the flow is lateral and clay layers under the coal do not allow it to leak into the underlying aquifer. A study of water well logs within 10 miles of Todd Mine revealed the existence of three separate aquifers. A pilot plan for Todd Mine is proposed to discharge the uncontaminated water from the upper aquifer to the lower fresh aquifer under the concept of "weeping wells." The acid discharge from the mine may be stopped. The extension of this scheme may solve the serious problem of pollution of Lake Hope. The concept may further be extended to other areas of the Appalachian region to control acid mine pollution. — Author's abstract

06039 **Aki, K.; Tsai, Y. B.** Comparison of SH waves from large and small explosions [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 479-480, 1970.

06138 **Akin, R. H., Jr.; Graves, R. W., Jr.** Reply [to discussion by Curt Teichert of "Reynolds oolite of southern Arkansas," 1969]: Am. Assoc. Petroleum Geologists Bull., v. 54, no. 9, p. 1749, 1970.

We are not confused in our understanding of the term "oolite" even though it has two meanings. Our double usage is merely perpetuation and not innovation. *See* ibid., v. 53, no. 9, p. 1909-1922, 1969; Abs. North American Geology, March 1970. — SEF

06040 **Albee, Arden L.** Reaction relations of chloritoid and staurolite in pelitic schists [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 480-481, 1970.

Alexander, C. C. *See* Thorpe, A. N. 06298

Alexander, Vera. *See* Barsdate, Robert J. 00018

06252 **Allaart, J. H.** Field investigations in the Ketilidian rocks of the Nanortalik-Tasermiut region, *in* Report of activities, 1969: Grönlands Geol. Undersögelse Rap. 28, p. 37-38, illus., 1970.

Amphibolite horizons between gneisses and quartzites along Tasermiut and Söndre Sermilik fjords suggest basic volcanic rocks at two levels in the Ketilidian supracrust, as well as at the top. Bottom to top succession is: pelitic to semipelitic gneisses, volcanics, feldspathic quartzite, volcanics. The pelitic components north of Tasermiut are characterized by the paragenesis biotite-cordierite-microcline-plagioclase-quartz. Only close to the northwestern edge of the gneiss area is there andalusite, thought to be result of regional metamorphism. The basement appears to have been considerably mobilized during the Ketilidian plutonic episode; the main anticlinal core, granodiorite, has many double folded bands of amphibolite, interpreted as dikes in a pre-Ketilidian basement. Migmatization in the gneisses varies with amount of pegmatites, many of which are in lowest volcanics; the oldest are strongly folded. — GDC

06368 **Allard, Gilles O.** Geology of the northwest quarter of Lemoine Township, Abitibi-East County [also French edition]: Quebec Dept. Nat. Resources Prelim. Rept. 589, 16 p., tables, geol. map, 1970.

This area, straddling Chibougamau Lake, contains a small triangle of mainland and several islands, two of them drumlins without outcrop. The Precambrian bedrock is the stratiform Lac Doré Complex of greenschist anorthosites, and the Chibougamau Pluton of zoned diorite-tonalite occupying the axial zone of a large regional anticline. The contact is a wide breccia zone with xenoliths of anorthosite and gabbro in matrix of diorite and tonalite. Chemical analyses are tabulated of the pluton's various rock types. The area is crisscrossed by major faults, minor mineralized shears revealing rare molybdenite, and many dikes ranging from pyroxenite to pegmatite, most commonly the gray feldspar porphyry so important in copper mines of Doré Lake area. A major dike of olivine diabase is part of a swarm postdating metamorphism of all other rock types here. The structural interpretation here should influence future ore exploration. — GDC

Allison, Edwin C. *See* Hawkins, James W. 00011

05989 **Al-Rawi, Amin Hamad.** Quantitative mineralogical analysis of some soils in Iraq and of Antigo silt loam catena in Menominee County, Wisconsin [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 12, pt. 1, p. 5323B, 1970.

06041 **Alsop, L. E.; Goodman, A.; Ash, E.** Surface wave dispersion in elastic half spaces with surface mass loading [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 482, 1970.

06224 **Am. Geological Institute Staff.** American Geological Institute: Geotimes, v. 17, no. 8, p. 17-21, 1970.

In November 1948, the American Geological Institute was founded as a federation of 11 societies, under the National Academy of Sciences. In 1963, it was reorganized and incorporated as an independent nonprofit scientific and educational organization, and is directed by the House of Society Representatives composed of delegates

from each of the 17 member societies. Projects, described briefly here, are grouped into the following programs: education, geoscience information, manpower, public affairs, and administrative services. — ESL

Amaral, Eugene L. *See* Pryor, Wayne A. 00037

06452 **Amos, Dewey H.** Geologic map of parts of the Alton and Derby quadrangles, Meade and Breckinridge Counties, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-845, scale 1:24,000, section, text, 1970.

Limestone, the chief known resource in the Alton and Derby quadrangles, is available from several Mississippian formations. — MCM

Amos, Nur. *See* Kanamori, Hiroo. 06288

06042 **Amsden, Thomas W.** A late Ashgillian (Ordovician) brachiopod fauna from the Edgewood Formation, Illinois and Missouri [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 482-483, 1970.

00031 **Andersen, D. W.; Picard, M. Dane.** Quartz extinction in siltstone: Geol. Soc. America Bull., v. 82, no. 1, p. 181-185, illus., table, 1971.

The distribution of extinction types in siltstone from the Red Peak Formation (Early Triassic) of Wyoming and the Spearfish Formation (Permian-Triassic) of South Dakota are summarized in this paper. Results indicate that the amount of nonundulatory extinction, monocrystallinity, and inclusion-free grains in quartz of these rocks is extremely variable. Variability of these characteristics decreases, and the minimum observed values increase, however, with decreasing grain size. — Authors' abstract

06044 **Anderson, A. T.; Gottfried, David.** The significance of phosphorous, titanium, and niobium for the origin of calc-alkaline magma series [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 483-484, 1970.

06043 **Anderson, Alfred T.** The hybrid andesite of East Sand Butte, Modoc County, California [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 483, 1970.

Anderson, Daniel. *See* Fryxell, Roald. 06276

06309 **Anderson, F. D.** Geology of McKendrick Lake map-area, New Brunswick (21 J/16) (with a contribution by George D. Hobson): Canada Geol. Survey Paper 69-12, p. 1-9, illus., geol. map, 1970.

In this area of the northeastern Appalachians, Cambro-Ordovician paragneiss, schist and phyllite, the core of a large NE-trending anticlinorium, appear to have undergone at least three stages of deformation. Overlying them with apparent unconformity is a sequence of basic volcanics and interbedded slate, and siltstone dated by graptolites as Upper Silurian. Slate, siltstone, graywacke, and minor volcanics form the bulk of the remaining Paleozoic units, contiguous to south and dated as Ordovician or Silurian. Ordovician to Devonian granitic rocks crop out in the western part. Near horizontal Carboniferous strata, unconformable over Ordovician and Silurian units, have flora correlative with the Pennsylvanian Clifton Formation. A fault that strikes ENE across the southern part of the area appears to be strike-slip with displacement of 4 miles. — GDC

06174 **Anderson, Lennart A.; Johnson, Gordon R.** Induced polarization and resistivity surveys on Cleary Summit, Alaska, *in* Geological Survey research 1970, Chap. D: U.S. Geol. Survey Prof. Paper 700-D, p. D125-D128, illus., 1970.

Induced polarization and resistivity surveys were made on the north flank of Cleary Summit about 16 air miles north-northeast of Fairbanks, Alaska. Data were obtained along three traverses that were positioned to transect some of the known vein structures that have produced gold, silver, and other metallic minerals. Two disseminated sulfide concentrations of possible economic interest, one deep seated and the other about 75-100 feet beneath the surface, were detected. — Authors' abstract

06175 **Anderson, Lennart A.; Reed, Bruce L.; Johnson, Gordon R.** Geologic interpretation of a residual aeromagnetic map of the Nixon Fork district, Alaska, *in* Geological Survey research 1970, Chap. D: U.S. Geol. Survey Prof. Paper 700-D, p. D129-D133, illus., 1970.

A residual aeromagnetic map covering approximately 480 square miles was compiled for the Nixon Fork district located about 35 miles northeast of McGrath, Alaska. The aeromagnetic survey was flown in search of concealed intrusive rocks similar to the quartz monzonite stocks that have produced contact metamorphic deposits in limestone, the principal source of gold in the district. Negative magnetic anomalies are associated with quartz monzonite stocks, establishing a useful criterion for locating favorable prospecting areas. Some new localities of possible economic interest in this area are discussed. — Authors' abstract

06267 **Anderson, Orson L.; Scholz, Christopher; Soga, Naohiro; Warren, Nicholas; Schreiber, Edward.** Elastic properties of a micro-breccia, igneous rock and lunar fines from Apollo 11 mission, *in* Apollo 11 Lunar Sci. Conf., Houston, Tex., 1970, Proc. — V. 3, Physical properties: New York, and Oxford, England, Pergamon Press (Geochim. et Cosmochim. Acta Supp. 1), p. 1959-1973, illus., tables, 1970.

Elastic properties at ambient conditions and as functions of pressure were measured on lunar rocks (10017 and 10046) and on fines (10084). Sphere resonance technique was applied to selected glass spheres picked from the lunar soil. Data from all of these measurements yielded mutually consistent results, on the basis of which it was possible to suggest three models of the lunar near surface mare region. These models indicate that at any given depth, velocities can be significantly lowered as a result of structural heterogeneity and lack of water. — Authors' abstract

06045 **Anderson, Thomas H.; Silver, Leon T.** Reconnaissance survey of Precambrian rocks, northwestern Sonora, Mexico [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 484, 1970.

05835 **Andrew, E. M.; Smith, D. Masson; Robson, G. R.** Gravity anomalies in the Lesser Antilles: [Great Britain] Inst. Geol. Sci. Geophys. Paper 5, 21 p., illus., tables, 1970.

A belt of large positive gravity anomaly follows the volcanic island arc of the Lesser Antilles and is flanked to the east by an equally pronounced belt of negative anomaly; isostatic anomaly changes exceeding 300 mgal have been observed. The islands, composed mainly of volcanic rock, occupy a very small part of the area so that the source of the gravity anomalies is not evident from geological observation. The positive anomaly belt appears to be due to a zone 100 km wide of material of lower crustal density emplaced in the upper crust. Large anomaly gradients and curvatures rule out the possibility that an appreciable part of the anomaly originates in the lower crust or mantle. The negative anomaly belt may be due in part to considerable thicknesses of recent sediments on the sea floor, but may also arise from isostatic compensation for the crustal load implied by the positive anomaly belt. — *from* Authors' abstract

05970 **Andrews, J. T.; Dugdale, R. E.** Age prediction of glacio-isostatic strandlines based on their gradients: Geol. Soc. America Bull., v. 81, no. 12, p. 3769-3771, illus., table, 1970.

Scandinavian research has shown that strandline gradients decrease exponentially toward the present day. The relationship of gradient to age can be used to estimate the time of formation of a strandline that has not been directly dated, provided that: (1) the gradient of the strandline has been determined, and (2) both gradient and age estimates for two or more other strandlines in the series are available. As an example, six strandlines of previously unknown age in southeast Scotland are dated by means of an expression devised from the age and gradient of three other strandlines from the same series. Any such relationship, however, is valid only for the local area. — Authors' abstract

06319 **Andrews, John T.** A geomorphological study of post-glacial uplift, with particular reference to Arctic Canada: Inst. British Geographers Spec. Pub. 2, 156 p., illus., tables, 1970.

Chapters in this synthesis of work on postglacial emergence in Arctic Canada are: introduction; glacial chronology of arctic and northern North America — eustatic sea levels; postglacial uplift and emergence — methods and results; shoreline relation diagrams — physical basis and use; pattern and interpretation of marine limits and amount of postglacial uplift; form and interpretation of crustal warping — two-dimensional analyses; construction of isobase maps — three-dimensional analysis of crustal deformation; rates of postglacial uplift — spatial and temporal variations; residual uplift; restrained rebound; and summary and discussion. — MCM

06339 **Anuta, Paul E.** Spatial registration of multispectral and multitemporal digital imagery using fast Fourier transform techniques: IEEE Trans. Geosci. Electronics, v. GE-8, no. 4, p. 353-368, illus., tables, 1970.

A system for spatial registration of digitized multispectral and multitemporal imagery is described. Multispectral imagery can be obtained from multilens cameras, multichannel optical-mechanical line scanners, or multiple vidicon systems employing techniques to sense selected portions of the spectrum. Spatial registration is required for multidimensional analysis on contextually similar image elements from different wavelength bands. The fast Fourier transform technique for cross correlation of misregistered imagery to determine spatial distances is discussed in detail. A method of achieving translational, rotational, and scaling corrections between images and use of the system for registration of multispectral airborne line-scanner imagery and space photography are described. Application to preprocessing of earth-resources satellite imagery from systems such as ERTS scanner and vidicon system is discussed. — *from* Author's abstract

Archambault, Ginette. *See* Valiquette, Guy. 06214

06046 **Archambeau, Charles B.; Sammis, Charles.** Seismic radiation from explosions in prestressed media and the measurement of tectonic stress in the Earth [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 484-485, 1970.

06413 **Armstrong, Baxter H.** Reply to "Comments on rock bursts, outbursts, and earthquake prediction": Seismol. Soc. America Bull., v. 60, no. 6, p. 2087-2088, 1970.

The paper under discussion was published in ibid., v. 59, no. 3, p. 1259-1280, 1969; Abs. North American Geology, January 1970.

06217 **Armstrong, R. L.; Barton, J. M.; Carmalt, S. W.; Crowley, W. P.** Geochronologic studies of the Prospect, Ansonia, and Milford Formations, southern Connecticut, *in* Contributions to geochronology in Connecticut: Connecticut Geol. and Nat. History Survey Rept. Inv. 5, p. 19-27, illus., tables, 1970.

An isochron for the Prospect and Ansonia formations gives a date of 410 ± 10 m.y., with an initial Sr-87:Sr-86 ratio of 0.710. A two-point isochron for the Maltby Lakes Volcanics of the Milford Formation gives a date of 460 m.y. and several samples indicate an initial Sr-87:Sr-86 ratio of 0.705. An east-west-trending boundary separates a northern area with K-Ar dates 316 to 345 m.y. from a southern area with dates 226 to 272 m.y. The results are consistent with the interpretation that the Prospect and Ansonia formations are metavolcanics high in the local stratigraphic section and that regional metamorphism and deformation is Acadian (Devonian). — Authors' abstract

06188 **Arnow, Ted.; VanHorn, Richard; LaPray, Reed.** The pre-Quaternary surface in the Jordan Valley, Utah, *in* Geological Survey research 1970, Chap. D: U.S. Geol. Survey Prof. Paper 700-D, p. D257-D261, illus., table, 1970.

The altitude of the base of the Quaternary deposits in the Jordan Valley, Utah, was determined by interpretation of drillers' logs of water wells supplemented with some geological and geophysical data. The pre-Quaternary surface of the valley generally was similar to the present land surface but had considerably more relief. A map showing contours of the base of the Quaternary deposits can be used as a general guide for water-well drilling and for preliminary determination of the depth to firmest foundation materials. — Authors' abstract

Arrhenius, G. *See* Asunmaa, S. K. 06268

Ash, E. *See* Alsop, L. E. 06041

06047 **Asseez, L. O.** Design of earth roads in developing countries [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 485, 1970.

06268 **Asunmaa, S. K.; Liang, S. S.; Arrhenius, G.** Primordial accretion, inferences from the lunar surface, *in* Apollo 11 Lunar Sci. Conf., Houston, Tex., 1970, Proc. — V. 3, Physical properties: New York, and Oxford, England, Pergamon Press (Geochim. et Cosmochim. Acta Supp. 1), p. 1975-1985, illus., 1970.

Ablation, transport, and accretion of solids, liquid, and vapor on lunar rock and particle surfaces reveal mechanisms which are likely to be of fundamental importance in primordial accretion. — Authors' abstract

05990 **Atkinson, Ian Athol Edward.** Rates of ecosystem development on some Hawaiian lava flows [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 12, pt. 1, p. 5323B-5324B, 1970.

Atwater, Tanya. *See* Grow, John A. 06118

06124 **Atwater, Tanya.** Implications of plate tectonics for the Cenozoic tectonic evolution of western North America: Geol. Soc. America Bull., v. 81, no. 12, p. 3513-3535, illus., 1970.

Magnetic anomaly patterns in the northeast Pacific Ocean combined with plate theory indicate that a trench existed offshore from western North America during mid-Tertiary time and that the present episode of strike-slip motion in the San Andreas fault system originated after the cessation of subduction, not earlier than 30 m.y. ago. At present, the American and Pacific plates appear to be moving past one another parallel to the San Andreas fault at a rate of 6 cm/yr. Data concerning the late Cenozoic history of motions between these plates in inconclusive, and so 2 probable models are examined. One assumes a constant motion of 6 cm/yr throughout the late Cenozoic, whereas the other assumes that the 2 plates were fixed with respect to one another until 5 m.y. ago, at which time they broke along the San Andreas fault system and began moving at 6 cm/yr. — *from* Author's abstract

06446 **Auzende, Jean-Marie; Olivet, Jean-Louis; Bonnin, Jean.** La marge du Grand Banc et la fracture de Terre-Neuve [The margin of the Grand Banks and the Newfoundland fracture]: Acad. Sci. Comptes Rendus, ser. D, v. 271, no. 13, p. 1063-1066, illus., 1970.

Seismic and magnetic profiles south of the Grand Banks of Newfoundland show a fracture zone which drops the continental margin and extends southeastward toward the Azores. This fracture zone is evidence of eastward drift of Africa since the opening of the Atlantic in Jurassic or Triassic time. Starting from the southeast corner of the Grand Banks, the fracture zone supports a sedimentary ridge built by bottom currents, extending as far as the 40° W. meridian. — DBV

06048 **Ayer, Nathan.** X-radiography of intact sediment cores from southern Lake Michigan [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 484-485, 1970.

06049 **Bachhuber, Frederick W.** The effects of differential preservation in a pollen analytical study [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 486, 1970.

Baedecker, M. J. *See* Brown, Frederick S. 06073

05942 **Baer, N. S.; Lewin, S. Z.** The replacement of calcite by fluorite, a kinetic study: Am. Mineralogist, v. 55, nos. 3-4, p. 466-476, illus., tables, 1970.

Calcium carbonate mineral specimens were transformed to fluorite in NH_4F solutions. With calcite single crystals, the combination of epitaxy and the anisotropy of the reaction led to the formation of elongated hexagonal etch pits. The reaction rate was shown to be directly proportional to the $F0^-$ concentration and the surface area. The initial reaction rates were used to obtain estimates of the effective surface area, as contrasted to the geometrical surface area, for porous specimens. Comparison of the experimental rate curves with theoretical rate curves showed that the rate of reaction at the phase boundary was an important, if not the only, rate determining step. — Authors' abstract

05797 **Baie, Lyle F.** Possible structural link between Yucatán and Cuba: Am. Assoc. Petroleum Geologists Bull., v. 54, no. 11, p. 2204-2207, illus., 1970.

Oceanographic investigations along the eastern margin of the Yucatán Peninsula (Quintana Roo Territory) have revealed the presence of two ridges separated by a depression, which parallel the Yucatan coast. The strike of the eastern, or Outer Ridge (north-north-east) changes to northeast at the northern end of this ridge and reaches toward the Cuban shelf. The origin of the Outer Ridge is unknown, but possibly it is a remnant of a Paleozoic fold belt that connects the basement rocks beneath the ridge east of British Honduras (Turneffe Island well) with basement rocks on the Isle of Pines (Cuba). — Author's abstract

06050 **Bain, Roger J.** Alteration and replacement of chert by carbonates in Ordovician limestone near Staunton, Virginia [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 486-487, 1970.

06051 **Baker, Donald R.** Organic geochemistry and geological interpretations [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 487, 1970.

06052 **Baker, Ian; Ridley, William I.** Field and geochemical data bearing on the origin of the Mount Taylor volcanic field, New Mexico [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 487-488, 1970.

06411 **Baker, R. G.** Determining magnitude from Lg: Seismol. Soc. America Bull., v. 60, no. 6, p. 1907-1919, illus., tables, 1970.

An empirical method is developed for determining magnitude of seismic events from amplitude of Lg recorded at local to regional distances. Data used were obtained from Long Range Seismic Measurements (LRSM) reports for 78 nuclear explosions. Magnitudes calculated from Lg recordings had less scatter than body-wave magnitudes reported for the same events and stations. A sixth-degree polynomial gave the best fit to log amplitude/period values plotted as a function of epicentral distance. Amplitude-distance correction factors are presented. Magnitudes from Lg were compared to average unified magnitudes from LRSM shot reports; for 60 of 68 events, the standard deviation for M was less than that for m. All M values were normalized to magnitude 5.0, and average residuals were found for 69 stations. A map of residuals indicates that they represent station corrections rather than azimuthal variations. Apparent station corrections are presented for 23 stations. — DBV

06156 **Baker, Richard G.** A radiocarbon-dated pollen chronology for Wisconsin — Disterhaft Farm Bog revisited [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 488, 1970.

Banner, J. A. *See* Freeze, R. A. 05812

Barefoot, R. R. *See* Foscolos, A. E. 06220

06053 **Barker, Colin.** The gases in rocks and their contribution to the Earth's atmosphere [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 489, 1970.

06054 **Barker, Colin.** The importance of temperature in abnormal pressure zones [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 489-490, 1970.

05958 **Barnard, Walther M.** Memorial of Harold Douglas Wright — November 11, 1921-July 7, 1969: Am. Mineralogist, v. 55, nos. 3-4, p. 614-619, portrait, 1970.

05863 **Barnett, Stockton G.** A new stage for orienting microfossils: Jour. Paleontology, v. 44, no. 6, p. 1133-1134, illus., 1970.

The construction, entirely from plexiglass, of an inexpensive attachment for a mechanical stage of a microscope to aid in the orientation of microfossils and other specimens is described. The body of the stage, a machine-lathed 1 1/2-inch radius hemisphere, tilts freely on a ring base. — JWH

Barnette, D. E. *See* Hamilton, J. B. 06383

Barr, S. *See* Chase, R. L. 06093

Barrer, R. M. *See* Kerr, I. S. 05940

00018 **Barsdate, Robert J.; Alexander, Vera.** Geochemistry and primary productivity of the Tangle Lake system, an Alaskan alpine watershed: Arctic and Alpine Research, v. 3, no. 1, p. 27-41, illus., tables, 1971.

Chemical, biological, and a few physical parameters were determined on six lakes and the major tributaries in the Tangle Lakes. The waters are of the calcium bicarbonate type and are of low to moderate hardness (16 to 48 mg $CaCO_3$ liter^{-1}). Major ionic components in the lakes decrease downstream. Transition metals, cobalt, copper, iron, manganese, and zinc are present at unusually low concentrations, although other nutrients are relatively abundant (mean reactive phosphorus 0.4 μg-at liter^{-1}; nitrate-N 2.7 μg-at liter^{-1}). Despite a short ice-free season and high wind velocities, the deeper lakes develop strong thermal stratification, and surface temperatures reach 17°C late in July. The waters are fairly transparent, a factor of importance to plant productivity. Photosynthetic carbon fixation by plankton algae occurs at modest intensities, the mean in the euphotic zone being about 80 mg C m^{-3} day^{-1}. When integrated over the water column production is as much as 635 mg C m^{-2} day^{-1}. — *from* Authors' abstract

Barton, J. M. *See* Armstrong, R. L. 06217

06269 **Bastin, J. A.; Clegg, P. E.; Fielder, G.** Infrared and thermal properties of lunar rock, *in* Apollo 11 Lunar Sci. Conf., Houston, Tex., 1970, Proc. — V. 3, Physical properties: New York, and Oxford, England, Pergamon Press (Geochim. et Cosmochim. Acta Supp. 1), p. 1987-1991, illus., reprinted 1970.

The infrared absorption properties of lunar rock throughout the range 2-2000μm were investigated and, in addition, direct measurements of specific heat and thermal conductivity of rock samples were made. The results suggest that pure radiation is an important, if not dominant, process in heat flow in the lunar surface layer. A new method for determining the mean conductivity of this layer gives somewhat lower values than earlier Earth-based measurements. There is also evidence to suggest that, at depths of about 10 m, the rock is still of a porous and fragmental nature. *Reprinted from 00*Science, v. 167, p. 728-730, 1970. — Authors' abstract

Battey, M. H. *See* Runcorn, S. K. 06292

06055 **Beall, Arthur O., Jr.** Turbidites of the Gulf of Mexico abyssal plain [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 490, 1970.

Beg, M. A. *See* Clarke, W. B. 06403

06056 **Beger, Richard M.; Burnham, Charles W.; Hays, James Fred.** Structural changes in sillimanite at high temperature [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 490-491, 1970.

06057 **Behrens, E. William; Land, Lynton S.** Subtidal, Holocene dolomite in Baffin Bay, Texas [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 491-492, 1970.

06058 **Bell, J. S.** Tertiary global tectonics in the southern Caribbean area [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 492, 1970.

05880 **Bell, R. T.** Preliminary notes on the Hurwitz Group, Padlei map-area, Northwest Territories: Canada Geol. Survey Paper 69-52, 13 p., illus., table, geol. map, 1970.

Studies of the Hurwitz Group at the northeast end of the Rankin-Ennadai belt have disclosed a pocket of older pyritic, mildly radioactive sedimentary rocks similar to those farther west at Montgomery Lake. Basic data on these and associated rocks are presented along with a figure showing the distribution of these rocks in the Padlei map-area. The lower formations of the Hurwitz Group are formally defined: Padlei Formation, Kinga Formation, including Maguse and Whiterock Lake Members, and Ameto Formation, including Happotiyik Member. — Author's abstract

Benson, R. *See* Berggren, W. A. 06160

06018 **Bentley, Eugene Macke, 3d.** The effect of marshes on water quality [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 12, pt. 1, p. 5576B, 1970.

06059 **Bentley, Robert D.; Neathery, Thornton L.** Southern terminus of the inner Piedmont zone, Alabama [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 492-493, 1970.

06160 **Berggren, W. A.; Laughton, A. S.; Davies, T. A.; Franz, Ulrich; Musich, Lillian; Ruffman, A.; Whitmarsh, Robert; Benson, R.; vanHinte, J. E.; Perch-Nielsen, Katharina.** Preliminary results of J.O.I.D.E.S. Deep Sea Drilling Project leg 12, North Atlantic [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 493, 1970.

Berkoff, E. W. *See* Crew, M. E. 05831

06157 **Berkson, J. M.; Clay, C. S.** A side-scan sonar study of the morphology of Lake Superior near Freda, Michigan [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 493-494, 1970.

Berman, R. M. *See* Sheridan, R. E. 00010

06240 **Bermúdez, Pedro J.; Seiglie, George A.** Age, paleoecology, correlation and foraminifers of the uppermost Tertiary formation of northern Puerto Rico: Caribbean Jour. Sci., v. 10, nos. 1-2, p. 17-33, illus., 1970.

The Camuy Formation as mapped by Monroe (1963, 1968) is herein correlated by its foraminiferal fauna with formations of other authors in Puerto Rico and with other formations of the Caribbean-Antillean region. For the three members, 35 benthonic and 17 planktonic species are listed and the planktonics are figured; the foraminifers represent environments ranging from fore reef to upper continental slope or deeper. The Camuy is considered latest Miocene to Pliocene in age, containing foraminifers of the *Globorotalia dutertrei*, *G. margaritae*, *Globoquadrina altispira altispira* zones of Bolli and Bermúdez (1965). In northern Puerto Rico, the Camuy is equivalent to the Quebradillas and upper part of the Los Puertos limestones of Berkey (1915) and Hubbard (1923) and to the upper part of the Aymamón Limestone of Zapp et al. (1948). — VMJ

05896 **Bernard, Hugh A.; Major, C. F., Jr.; Parrott, B. S.; LeBlanc, Rufus J., Sr.** Recent sediments of Southeast Texas — A field guide to the Brazos alluvial and deltaic plains and the Galveston barrier island complex: Texas Univ. Austin Bur. Econ. Geology Guidebook 11, [83] p., illus., 1970.

This reprint of a field guide, prepared by Shell Development Company and used in a 3-day industrial short course for full-time college teachers in geology, in Houston, 1970, in cooperation with AGI Council on Education in Geological Sciences, includes summaries and well-illustrated documentation of clastic depositional environments and related facies of the southeastern Texas Coast. The models presented, based on several years of detailed investigation and 3-dimensional reconstruction,

should be of interest in the interpretation and study of ancient depositional environments and modern counterparts. Parts 1 and 4 are cited separately. Stops observed in road log show alluvial, delta, and coastal interdeltaic and marine environments. — GDC

05897 **Bernard, Hugh A.; Major, C. F., Jr.; Parrott, B. S.** The Galveston barrier island and environs — A model for predicting reservoir occurrence and trend [summ.], *in* Recent sediments of Southwest Texas — A field guide to the Brazos alluvial and deltaic plains and Galveston barrier island complex: Texas Univ. Austin Bur. Econ. Geology Guidebook 11, 4 p., paged separately, reprinted 1970; originally published 1959.

This summary is reprinted from Gulf Coast Assoc. Geol. Soc. Trans., v. 9, p. 221-224, 1959.

05898 **Bernard, Hugh A.; LeBlanc, Rufus J.** Résumé of the Quaternary geology of the northwestern Gulf of Mexico Province, App. *in* Recent sediments of Southwest Texas — A field guide to the Brazos alluvial and deltaic plains and Galveston barrier island complex: Texas Univ. Austin Bur. Econ. Geology Guidebook 11, 62 p., paged separately, illus., reprinted 1970; originally published 1965.

This résumé is extracted from *The Quaternary of the United States* (H. E. Wright, Jr. and David G. Frey, editors): Princeton, N.J., Princeton Univ. Press, p. 137-185, 1965.

06060 **Berner, Robert A.** Chemical kinetic models of early diagenesis [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 494, 1970.

06168 **Berry, William B. N.** Pendent didymograptids from northern Arkansas, *in* Geological Survey research 1970, Chap. D: U.S. Geol. Survey Prof. Paper 700-D, p. D62-D70, illus., 1970.

Pendent didymograptids from two localities near Smithville, Ark., include *Didymograptus artus*, *D. bifidus*, *D.* cf. *D. bifidus*, and *D. smithvillensis* n. sp. These graptolites are indicative of the *Didymograptus bifidus* zone. Shelly fossils associated with the graptolites at one locality are indicative of a latest Early Ordovician age and suggest that the *D. bifidus* zone ranges in age into the latest Early Ordovician from the earliest Middle Ordovician, with which it had previously been correlated. The pendent didymograptids from the Smithville area reveal a relatively wide range in morphologic variation that is comparable to morphologic variation observed among similar pendent didymograptids from most other localities in North America and western Europe at which they are abundant. — Author's abstract

06312 **Besancon, James R.** A Rb-Sr isochron for the Nonewaug Granite, *in* Contributions to geochronology in Connecticut: Connecticut Geol. and Nat. History Survey Rept. Inv. 5, p. 1-9, illus., table, 1970.

The Nonewaug Granite, an igneous body characterized by the presence of graphic granite and plumose muscovite, intrudes deformed eugeosynclinal metasediments of lower Paleozoic age in western Connecticut. Five whole rock samples define a Rb-Sr isochron, giving a date of 382 ± 64 m.y. for the granite. This is a minimum age for the Acadian orogeny in the crystalline rocks of southern New England. — Author's abstract

06061 **Bhattacharji, S.** Scale models for natural and forced thermal convection in basaltic and syenitic magmas [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 494-495, 1970.

Bhattacharyya, B. K. *See* Holroyd, M. T. 06303

06062 **Bickford, M. E.; Turner, Brian B.** Rb-Sr geochronology of gneisses in structural domes, southeastern Adirondack Mountains, New York [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 495, 1970.

06345 **Biggs, R. B.** Sources and distribution of suspended sediment in northern Chesapeake Bay: Marine Geology, v. 9, no. 3, p. 187-201, illus., tables, 1970.

Sources and losses of total suspended matter and organic carbon are identified and estimated for northern Chesapeake Bay. Suspended matter in the northernmost segment is dominated by a fluvial source with a significant contribution from shore erosion. About 23 percent of total input of particulate matter is lost from the northernmost sector, but only 4 percent escapes down stream while 19 percent is organically oxidized within the area. The nominal sedimentation rate for the northern bay is 3.7 mm/year. The middle section is dominated by sources of suspended matter from shore erosion and phytoplankton production. Approximately 41 percent of total mass of suspended matter is lost from the middle bay — 23 percent downstream, and 18 percent organically oxidized. Nominal sedimentation for the middle bay is 1.1 mm/yr. — *from* Author's abstract

05881 **Bird, J. Brian.** Some aspects of the geomorphology of the Eastern Townships of Quebec [with French and Russian abs.]: Rev. Géographie Montreal, v. 24, no. 4, p. 417-429, illus., 1970.

Landscape evolution of the southern Eastern Townships began on a land surface of which no traces remain; parts of the drainage pattern have survived, in spite of frequent and repeated capture leading to development of a master stream, the St. Francis. The Appalachian Platform, dominating the morphology, is a composite of many planation surfaces rising in identifiable steps toward highlands on the international border. Late Tertiary and Quaternary denudation has varied from rapid, when rivers became entrenched, to slow and long-lasting, when major planation surfaces formed. Two major stable phases are recognized creating the Dufferin and Magog surfaces. Stages in development of the drainage system can be referred to erosional phases by the presence of abandoned water gaps. The early Quaternary appears to have been a period of rapid stream entrenchment; later erosional history is confused by glaciation. — *from* Author's abstract

06270 **Birkebak, R. C.; Cremers, C. J.** Directional spectral and total reflectance of lunar material, *in* Apollo 11 Lunar Sci. Conf., Houston, Tex., 1970, Proc. — V. 3, Physical properties: New York, and Oxford, England, Pergamon Press (Geochim. et Cosmochim. Acta Supp. 1), p. 1993-2000, illus., tables, 1970.

The directional reflectance was measured for lunar fines and chips from three different lunar rocks. The spectral reflectance of the fines varied from approximately 7.0 per cent at 0.6 μ to 15 per cent at 2.0 μ. The total reflectance for white light at near normal incidence is approximately 10 per cent. The reflectance increased by approximately 40 per cent when the angle of illumination was increased from 20° to 60°. — Authors' abstract

Birkebak, R. C. *See* Cremers, C. J. 06273

06063 **Birkeland, Peter W.** Late Quaternary sea-level changes along the Malibu Coast, Santa Monica Mountains, California [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 495-496, 1970.

Birmingham, T. F. *See* Cameron, A. R. 05821

06064 **Bishop, Donald; Morris, Hugh C.; Edmunds, Frederick R.** Turbidites and depositional features in the Lower Belt-Purcell Supergroup [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 497, 1970.

05888 **Bissell, H. J.** Petrology and petrography of Lower Triassic marine carbonates of southern Nevada (U.S.A.): Leiden, Netherlands, E. J. Brill (Internat. Sedimentary Petrographical Ser., V. 14), 27 p., 82 plates, 1970.

The first part of this book consists of a text and figures relating to the present geologic setting, and in turn to Permo-Triassic, then Triassic paleogeography, tectonics, stratigraphy, basins and other realms of carbonate sedimentation, and to previous petrographic investigations. The second part consists of 150 photomicrographs of thin sections, accompanied by descriptions identifying the microfacies. — VSN

Black, Lance P. *See* Kohman, Truman P. 06436

05833 **Black, Robert F.** Glacial geology of Two Creeks Forest Bed, Valderan Type Locality, and Northern Kettle Moraine State Forest — Geol. Soc. America, Ann. Mtg., Milwaukee, Wis., 1970: Wisconsin Univ. Geol. and Nat. History Survey Inf. Circ. 13, 40 p., illus., tables, 1970.

This guidebook for Glacial Geology Field Trip 9 includes a detailed road log and reports on the glacial geology of the Two Creeks buried forest, the Valders drift type locality and the Northern Kettle Moraine State Forest. At the Two Creeks Forest Bed site near the Lake Michigan shore of Wisconsin, the sequence of the soil containing remnants of the forest overridden by the Valderan glacier is described. The Valderan drift locality in the Valders Lime and Stone Company quarry shows a sequence of red clayey drift with bedrock striae at right angles to those of older, partially replaced, gray stony drift. The report on the Northern Kettle Moraine State Forest describes the excellently developed and representative glacial features present there as well as their origin. — EH

06271 **Blair, I. M.; Edgington, J. A.** Luminescence and thermoluminescence under 159 MeV proton bombardment of the lunar material returned by Apollo 11, *in* Apollo 11 Lunar Sci. Conf., Houston, Tex., 1970, Proc. — V. 3, Physical properties: New York, and Oxford, England, Pergamon Press (Geochim. et Cosmochim. Acta Supp. 1), p. 2001-2012, illus., table, 1970.

We have bombarded material returned by Apollo 11 with 159 MeV protons and have observed a red luminescence, qualitatively similar to that of enstatite achondrites, in unsorted fines, their separated mineral phases, and rock chips. The energy efficiency of the plagioclase fraction is approximately 1 per cent. At -196°C the efficiency is greater by a factor between one and two. All fractions except ilmenite exhibit blue thermoluminescence after this proton irradiation at -196°C, with a glow peak near -135°C and an energy efficiency about 4×10^{-6}. Unlike the thermoluminescence of terrestrial and meteoritic material it is nonrepeatable after annealing at 200°C. Similar thermoluminescence is seen in rock chips, but in unsorted fines it is masked by the opaque fractions. — Authors' abstract

Blander, M. *See* Housley, R. M. 06286

06065 **Bloom, Arthur L.** Decreasing area and volume of Wisconsin-age ice sheets correlated with rising sea level [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 497-498, 1970.

Bogard, D. D. *See* Schaeffer, O. A. 06437

Bohnenberger, Otto. *See* Dengo, Gabriel. 06229

06342 **Bold, W. A. van den.** Ostracoda of the lower and middle Miocene of St. Croix, St. Martin and Anguilla: Caribbean Jour. Sci., v. 10, nos. 1-2, p. 35-61, illus., tables, 1970.

Stratigraphic relationships between the Jealousy and Kings Hill formations of St. Croix, Anguilla Formation of Anguilla, and Lowlands Formation of St. Martin, and Miocene formations of other West Indies islands are shown by lithology, foraminiferal zones, and ostracode faunas. Ostracodes of 18 genera and 30 species are described and figured, including three new species, *Caudites sacer*, *Quadracythere sparse*, *Loxoconcha runa*. The brackish-water faunas of the basal Anguilla and Jealousy are similar; the upper Anguilla and lower Lowlands faunas are almost identical; the upper Lowlands and lower Kings Hill faunas are similar; the Jealousy-Kings Hill contact is not exposed. Stratigraphic distribution is charted for 62 ostracode species in the three islands; distribution charts for early and middle Miocene ostracodes of Trinidad (Bold, 1957, 1958) are updated. — VMJ

Bolke, E. L. *See* Price, Don. 05824

06066 **Bollinger, G. A.** Microearthquake activity associated with underground coal-mining in Buchanan County, Virginia [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 498, 1970.

Boltz, D. F. *See* Likussar, W. 06349

06244 **Bondesen, E.** Field work in the Agto-Nordre Strömfjord region, *in* Report of activities, 1969: Gronlands Geol. Undersögelse Rap. 28, p. 17-19, 1970.

New information is summarized from this season's work by seven teams in West Greenland, mainly north of outer Nordre Strömfjord and around Giesecke. Long ENE-trending belts of metasediments were mapped, the coarse microcline granite of the mountain Kingigtoq controlling closures of their large synforms. Metadikes traversing agmatites in the Ataneq fjord region become sill-like below the synforms, and gneisses are retrometamorphosed. In the easternmost inlet from Nordre Strömfjord a narrow belt of migmatized Ugssuit marbles and banded biotite gneisses, garnet amphibolites and ultrabasics may be equivalents of the western metasediments, and quartzitic supracrustal rocks, pegmatized and migmatized, are 300 m thick near west end where cut off by a fault. Age relations are not yet definite, but there is metamorphic contrast between the two rock series, and metasediments are doubly folded. — GDC

06381 **Bonham, Harold F.** Geologic map and sections of a part of the Shoshone Mountains, Lander and Nye Counties, Nevada: Nevada Bur. Mines Map 38, scale 1:62,500, text, 1970.

Tertiary volcaniclastic rocks of Oligocene and Miocene age comprise about 90 percent of the exposed rocks in this part of the Shoshone Mountains. Permian metavolcanic rocks crop out over an area of about five square miles near War Eagle Canyon. Pliocene or Pleistocene basalt flows cover a few square miles north of Sunnyside Creek and surficial Quaternary deposits are present in valleys adjacent to the range and along major drainages. Normal faults are the dominant element of the Cenozoic structure. Mineral deposits include gold, silver, mercury, and uranium. — MCM

Bonis, Samuel. *See* Dengo, Gabriel. 06229

06067 **Bonnichsen, Bill.** Principal rock types in the southern part of the Duluth Complex, Minnesota [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 498-499, 1970; Econ. Geology, v. 65, no. 6, p. 736, 1970.

Bonnin, Jean. *See* Auzende, Jean-Marie. 06446

06121 **Borg, I. Y.; Heard, H. C.** Experimental deformation of plagioclases [with German abs.], *in* Experimental and natural rock deformation — Internat. Symposium, Darmstadt, Germany, 1969, Proc. (P. Paulitsch, editor): Berlin and Heidelberg, Germany, Springer-Verlag, p. 375-403, illus., tables, 1970.

Deformation structures are described for 11 plagioclases, An_2-An_{95}, deformed at 25°-800°, 5-10 kb pressure. At 800°C, 10 kb, all single crystal oriented favorably for albite and pericline twin gliding have yield strengths of about 2 kb; yield strengths of polycrystalline aggregates are 1.3 to 3.0 times greater. In both cases, yield strengths are lowered by increase in temperature and anomalously raised by factors of 1.5 to 2.5 by prior annealing. Albite and pericline twinning occur at 800°C, 10 kb in the composition range An_{30}-An_{93}, except for An_{44}. [010] slip and concomitant kinking occur in more sodic members; irrational deformation lamellae occur in An_{37}-An_{77}; the latter are planar discontinuities in positions of high resolved shear stress with strong preferred orientation with reference to crystallographic axes of grains. In these respects they differ from unvitrified lamellae in shock-deformed rocks. — *from* Authors' abstract

06068 **Born, Stephen M.** The role of hydrogeology in lake management [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 499, 1970.

06069 **Borns, Harold W., Jr.** Late Wisconsin fluctuations of the Laurentide ice sheet in New England [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 499-500, 1970.

06158 **Bostick, Neely H.** Clastic organic particles (phytoclasts) as indicators of thermal metamorphism in Franciscan and Great Valley Sequence Upper Mesozoic strata, California [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 500, 1970.

06392 **Bostrom, R. C.** Relationship of the world rift system to the fiord regions in Chile and British Columbia: Modern Geology, v. 1, no. 4, p. 261-273, illus., 1970.

The relationship of the world rift system to present-day tectonism in British Columbia and Chile is considered, and the fiord regions of the two countries are compared. The physiography of both areas and their recent tectonic activity are very similar. Gravity and magnetic anomalies fit the structural data gathered. It is concluded that the continental margin may have been subject to uplift and weakening by impregnation, followed by relaxational extension towards the ocean. — ESL

06128 **Bottino, M. L.; Fullagar, P. D.; Fairbairn, H. W.; Pinson, W. H. Jr.; Hurley, P. M.** The Blue Hills igneous complex, Massachusetts — Whole-rock Rb-Sr open systems: Geol. Soc. America Bull., v. 81, no. 12, p. 3739-3745, illus., tables, 1970.

Whole-rock Rb-Sr apparent ages of 365 ± 7 m.y. and 282 ± 8 m.y. were obtained for the Quincy Granite and Blue Hills Granite Porphyry, respectively. The Blue Hills aporhyolite does not yield an isochron. Published K-Ar hornblende ages and Pb-207/Pb-206 zircon ages for the Quincy Granite are 442 ± 22 m.y. and 450 ± 50 m.y., respectively. These ages plus the scatter of the Blue Hills whole-rock Rb-Sr data show that these rocks have not remained closed systems with respect to Rb and Sr since crystallization. — *from* Authors' abstract

06391 **Botz, M. K.** Development of a statewide system for computer processing of hydrogeological data: Montana Bur. Mines and Geology Spec. Pub. 49, 35 p., illus., tables, 1970.

Numerous computer-oriented data-processing systems are being used to store, retrieve, and manipulate hydrogeologic data; processing of well, spring, water-quality, water-level, and well-log data is of particular interest to many states. The U.S. Geological Survey and the Canadian government have developed national groundwater data-processing systems; the Federal Water Pollution Control STORET system, and others used by the oil industry and in other states, also may be of use in the development of a statewide ground-water data processing system. Of available processing systems, that of the U.S. Geological Survey is the most nearly complete and most useful for statewide use, but too limited in scope and flexibility to fit individual needs of most states. A comprehensive statewide system requires a computer facility, considerable funds, and skilled personnel. — *from* Author's abstract

06144 **Bowie, S. H. U.** Uranium — The present and the future, *in* Mining and petroleum geology — Commonwealth Mining and Metall. Cong., 9th, 1969, Proc., V. 2: London, Inst. Mining and Metallurgy, p. 405-420, illus., tables, 1970.

Shortage of uranium for nuclear power programs may be avoided by steps to reactivate mines, replace obsolete plants, and develop additional reserves. Some 80 percent of estimated reserves of non-Communist countries are strata-bound in conglomerates of Blind River, Ontario and the Witwatersrand, South Africa and in sandstones of the Colorado Plateau, here briefly described. Uraninite, metamorphic or epigenetic, occurs in deeply faulted strata, associated with repeated igneous and/or orogenic activity; the wide range in ages of origin appears also in vein deposits of other areas. With basic research intensified, and prospecting renewed worldwide, success will depend on: novel methods of locating hidden orebodies and differentiating radioactivity of various members of the uranium and thorium decay series; improved mining methods and *in situ* leaching; and beneficiation research to reduce costs of recovery from submarginal material. — GDC

06070 **Bowser, Carl J.; Callender, Edward; Rossmann, Ronald.** Electron probe and X-ray studies of fresh water ferromanganese nodules from Wisconsin and Michigan [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 500-501, 1970.

06379 **Brabb, Earl E.** (compiler). Preliminary geologic map of the Black River quadrangle, east-central Alaska: U.S. Geol. Survey Misc. Geol. Inv. Map I-601, scale 1:250,000, 1970.

06321 **Bradbury, J. C.; Hester, N. C.; Ruch, R. R.** Analyses of some Illinois rocks for gold: Illinois Geol. Survey Indus. Minerals Note 44, 14 p., illus., tables, 1970.

In order to provide information on possible sources of gold, the Illinois State Geological Survey has initiated a program of analyzing certain Illinois rocks for their gold content. Neutron activation, an extremely sensitive and relatively rapid method of analysis, was chosen as the most practical assaying tool. Materials tested to date include glacially derived silts, sands and gravels, peats, sandstones and black shales. Gold was not positively identified in any of the samples. Further testing of sands and gravels is planned. — Authors' abstract

06415 **Braddock, William A.; Calvert, Ronald H.; Gawarecki, Stephen J.; Nutalaya, Prinya.** Geologic map of the Masonville quadrangle, Larimer County, Colorado: U.S. Geol. Survey Geol. Quad. Map GQ-832, scale 1:24,000, sections, 1970.

05830 **Bradley, W. F.** Diskussionnye aspekty kristallokhimii sloistykh silikatov [Discussional aspects of the crystallochemistry of layered silicates (with English abs.)], *in* Problemy petrologii i geneticheskoy mineralogii, V. 2: Moscow, Akad. Nauk SSSR Sibir. Otdeleniye (Izdatel'stvo "Nauka"), p. 152-155, illus., 1970.

A short review is presented to propose relationships between the nature of layer silicate structure architecture and the principles of solution chemistry which lead to complex crystal composition. — Author's English abstract

Breed, William J. *See* Schreiber, John P. 00023

06155 **Bretsky, Peter W.** Benthic community structure of Middle Ordovician epeiric seas, upper Mississippi Valley [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 501, 1970.

06071 **Bricker, O. P.** Mineral equilibria, disequilibria and reaction rates in nature [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 502, 1970.

05911 **Bridges, L. W. Dan.** Paleozoic history of the southern Chihuahua tectonic belt [summ.], *in* The geologic framework of the Chihuahua tectonic belt — Symposium in honor of Ronald K. De Ford, Midland, Tex., 1970: Midland, Tex., West Texas Geol. Soc., p. 30-32, 1970.

06347 **Bridgwater, D.** A compilation of K/Ar age determinations on rocks from Greenland carried out in 1969, *in* Report of activities, 1969: Grönlands Geol. Undersögelse Rap. 28, p. 47-55, 1970.

Samples for K-Ar age determinations were selected for their geological criteria rather than suitability for precise isotopic measurement; problems were of regional character, such as basic dike chronology, or preliminary studies in areas where little isotopic age work had been done. Specific rocks sampled from different areas in Greenland are mostly from dike and sill intrusions of various Precambrian ages and character; their composition, emplacement relations, and alterations are briefly described. Several determinations show excess argon in basic dikes, implications of which are briefly discussed. — GDC

Briggs, Frank. *See* O'Leary, Brian. 06259

05991 **Briones, Angelina Mariano.** Nature and distribution of organic nitrogen in tropical soils [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 12, pt. 1, p. 5324B-5325B, 1970.

05882 **Brochu, Michel.** Présentation commentée d'un formulaire d'observation petrographique de terrain [An annotated presentation of a formulary for petrographic observations of the ground]: Rev. Géographie Montréal, v. 24, no. 4, p. 462-467, 1970.

Contents of the reporting form for use in field studies of sediments or soils presented here are: name of the observer; date; specimen number; location; absolute altitude; relative altitude above. . . . (geographic feature); slope of ground; type of sediment or soil; thickness of deposit or formation; form of deposit; vegetation; petrographic nature; index of quartz veins; bevelling of rocks; disposition in percentage of the pebbles and boulders in regard to the wind or to a stream; granulometric mode; calorimetric analysis, dry, and shaded from the sun's rays, using the Cailleux-Taylor color code; Ph; and remarks and interpretations. Forms for collections of the Centre de Recherches Arctique are included. — ESL

06072 **Brocoum, Stephan J.** Structural and metamorphic history of the major Precambrian gneiss belt, northwest Adirondacks, New York [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 502-503, 1970.

06405 **Broecker, Wallace; Kaufman, Aaron; Ku, Teh-Lung; Chung, Yu-Chia; Craig, Harmon.** Radium 226 measurements from the 1969 North Pacific Geosecs station: Jour. Geophys. Research, v. 75, no. 36, p. 7682-7685, illus., table, 1970.

Profile of Ra-226 with depth at the 1969 Geosecs calibration station in the Pacific Ocean was determined by four different groups of investigators. The Lamont-Doherty Group led by Broecker (LDGO-B) used the shipboard in situ method, the University of Southern California group (USC) and the Scripps Institution of Oceanography group (SIO) used the laboratory regenerated radon method, and the Lamont-Doherty group led by Kaufman (LDGO-K) used an isotope dilution method. Most measurements agree to within 15 percent. — Authors' abstract

06404 **Broecker, Wallace S.; Kaufman, Aaron.** Near-surface and near-bottom radon results for the 1969 North Pacific Geosecs station: Jour. Geophys. Research, v. 75, no. 36, p. 7679-7681, illus., tables, 1970.

Comparison of radon and radium results from the upper 100 meters of the water column at the Geosecs intercalibration station reveal deficiencies of radon consistent with those found at other places in the surface ocean. They suggest a gas exchange rate 'piston velocity' of approximately 6 m per day. In the bottom 100 meters of the water column radon excesses were found. As a maximum in the excess radon was observed 50 meters above the bottom in two separate casts, a simple vertical diffusion model cannot account for the observations. Lateral influx must be taking place. — Authors' abstract

05979 **Brooker, E. W.; Hayley, D. W.** A new look at the permafrost problem: Oilweek, v. 21, no. 37, p. 47-52, illus., 1970.

Distribution of permafrost in north circumpolar regions includes half of Canada. Constant factors determining its decay tend to stabilize climatic conditions; variable factors can be somewhat controlled and utilized to alter thermal balance to advantage. Freezing behavior of soils with its seasonal variations and continuous and discontinuous permafrost profiles is discussed; four methods of investigation are listed. Successful construction techniques follow from an understanding of the nature of permafrost. The key is prevention of thawing, by not disturbing natural insulation provided by organic soils. Gravel pads are used on surface, with cold-air ventilation, or piles frozen in or seated on hard, unfrozen substratum. Designs for dams, roads and airstrips, pipeline, and other structures depend on careful study of ice distribution in subsoils, to predict deformations due to thaw subsidence and its dragdown forces. — GDC

Brookins, Douglas G. *See* Chaudhuri, S. 06094

06216 **Brookins, Douglas G.** A summary of geochronological data for pegmatites of the Middletown, Connecticut, area accumulated mainly since 1952, *in* Contributions to geochronology in Connecticut: Connecticut Geol. and Nat. History Survey Rept. Inv. 5, p. 10-18, tables, 1970.

This article reviews geochronological investigations of pegmatites in the Middletown area, summarizes each age method used and tabulates age determinations obtained by each method since 1952. The author concludes that the pegmatites began to crystallize after about 270 m.y. and that the bulk of crystallization was completed by about 250 m.y., although local thermal activity continued for some 10 to 30 m.y. after that time. — EH

06179 **Brown, C. Ervin.** A sphalerite vein and associated geochemical anomalies in St. Lawrence County, New York, *in* Geological Survey research 1970, Chap. D: U.S. Geol. Survey Prof. Paper 700-D, p. D162-D168, illus., 1970.

In the Richville 7 1/2-minute quadrangle, St. Lawrence County, N. Y., a minor replacement vein of sphalerite parallel to layering in marble resembles the major mineralization in the Balmat-Edwards district 13 miles to the southeast. Geochemical sampling of soil in the vicinity of the vein shows a significant anomaly for zinc parallel to the strike of layering and the vein. Mercury as a pathfinder element even more sharply distinguishes the anomalous area. Lead does not show an anomaly; in fact, lead values are very low. Copper values are also low, but the proximity of the highest values to the sphalerite occurrence suggests an assocation of copper with the zinc mineralization. — Author's abstract

06159 **Brown, Edwin H.** Phase relations of stilpnomelane in the greenschist facies [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 503, 1970.

06073 **Brown, Frederick S.; Baedecker, M. J.; Nissenbaum, A.; Kaplan, I. R.** Diagenetic changes in organic matter from marine sediment [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 503-504, 1970.

06074 **Brown, G. E.; Novak, G. A.; Robinson, K. G.; Gibbs, G. V.; Ribbe, P. H.** Crystal chemistry of the orthosilicates [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 504-505, 1970.

06346 **Brown, G. Malcolm.** Petrology, mineralogy, and genesis of lunar crystalline igneous rocks: Jour. Geophys. Research, v. 75, no. 32, p. 6480-6496, illus., table, 1970.

Information on mineralogy and petrology of Apollo 11 crystalline basaltic rocks, obtained by some 35 groups of investigators, is summarized and used as a basis for speculation as to genesis. The hypothesis suffering the least number of restrictions is that a pyroxenite mantle has, during partial melting, given rise to basaltic magmas extruded on or near the surface. Local melting may have been preceded by regional melting of the outer pyroxenite layer early in the Moon's history, to produce a thin basaltic crust later enriched in feldspar at the top. Convection within part of the outer melted layer, or foundering of the anorthosite crust, could have produced the mare-highland configuration. Subsequent basaltic surface volcanism was confined chiefly to the maria, although plutons could have fractionated beneath the highlands. Meteor impact could expose plutonic cumulates in the deeper highland craters. Small pools of hybrid magma could have been produced by impact-generated melting of debris. — DBV

05922 **Brown, R. J. E.** Permafrost as an ecological factor in the Subarctic [with French abs.]; *in* Ecology of the subarctic regions (Ecologie des régions subarctiques)—Helsinki, Symposium, Proc.: Paris, UNESCO, p. 129-140, illus., table, discussion, 1970.

Permafrost in the subarctic is in close and complex correlation with a number of climatic and morphologic factors. The southern limit of the subarctic is debatable, but in considering permafrost, it is convenient to consider that the southern limit coincides with the southern limit of permafrost. In this paper, the tree line is considered the northern limit, so the subarctic includes all the discontinuous zone of permafrost and the southern part of the continuous zone. Climate is the most important factor influencing formation and existence of permafrost, and its distribution. Other factors are: terrain, relief, vegetation, drainage, snow cover, bare soil and rock, and glacier ice. — ESL

05823 **Bruch, John C., Jr.** Capillarity and seepage from an array of channels — Closure [to paper 6972, 1969: Am. Soc. Civil Engineers Proc., v. 96, Jour. Eng. Mechanics Div., no. EM5, p. 792, 1970.

Paper 6972 was published ibid., v. 95, no. EM6, p. 1403-1416, 1969; *see* Abs. North American Geology, May 1970. — GDC

06075 **Brucker, Roger W.; Hess, John W.; White, William B.** Role of vertical shafts in the movement of ground water in carbonate aquifers [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 505-506, 1970.

06076 **Brune, James; Tucker, Brian.** Spectra of seismic waves from small earthquakes [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 506, 1970.

05993 **Bryant, Vaughn Motley, Jr.** Late full-glacial and postglacial pollen analysis of Texas sediments [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 12, pt. 1, p. 5382B, 1970.

06337 **Buchanan, Chester L.** Optical and magnetic instruments for mapping the ocean floor: IEEE Trans. Geosci. Electronics, v. GE-8, no. 4, p. 320-325, illus., 1970.

Optical and magnetic sensors for mapping the ocean floor can be used to locate objects such as ships on the floor as well as to detect natural resources. The usefulness of still cameras is dependent on ability to cover large areas at a reasonable cost. The recent development of wide-angle lens systems has greatly increased the capabilities of photography. The use of magnetometers from deep-sea vehicles permits detection of anomalies not visible on surface magnetometers. A system is described briefly in which the sensor is towed at a considerable distance from the vehicle. Any system including both photographic and magnetic sensors should include good geodetic control and an accurate navigation system. The combination produces data from which small-scale magnetic and photographic maps can be made; often the cause of a natural magnetic anomaly is visible in photographs made simultaneously. — VSN

06077 **Bucknam, R. C.; Dickey, D. D.; McKeown, F. A.** Near-source ground deformation from the Handley nuclear explosion, Nevada Test Site [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 506, 1970.

00021 **Buerger, Martin J.** Introduction to crystal geometry: New York and London, McGraw-Hill Book Co., 204 p., illus., tables, 1971.

The objectives of this textbook are to provide a student with material for early years of undergraduate study as a preparation for chemistry, physics, mineralogy, metallurgy, and biology; and to be useful to the more advanced student in reading the original literature in his own field as it deals with crystallography. Chapter headings are: introduction, order in patterns, translational order, rotational order, point groups, lattice types and coordinate systems, application of point-group symmetries to crystals, characteristics of space groups, space groups, equipoints, and development of crystal geometry. — MCM

06078 **Bufe, Charles G.; Gedney, Larry D.; Tocher, Don.** Local deformations near the San Andreas fault [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 507, 1970.

06079 **Buma, Grant; Frey, F. A.; Wones, D. R.** Trace element abundances and the origin of some Massachusetts and Rhode Island granites [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 508, 1970.

Burford, R. O. *See* Savage, J. C. 06464

06080 **Burgess, Jack D.** Microscopic examination of kerogen (dispersed organic matter) in petroleum exploration [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 508-509, 1970.

06081 **Burkett, David H.; Scott, Robert B.; Leaird, James D.** Experimental alteration of basaltic glass in low temperature aqueous environments [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 509, 1970.

Burnham, Charles W. *See* Beger, Richard M. 06056

06082 **Burns, Roger G.; Greaves, C.; Law, A. D.; Tew, M. J.; Prentice, F. Jean.** Assessment of the reliability of the Mössbauer and infrared methods in site population studies of amphiboles [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 509-511, 1970.

06083 **Burns, Roger G.; Huggins, Frank E.** Cation determinative curves and evidence of ordering in Mg-Fe-Mn olivines from vibrational spectra [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 511-512, 1970.

Butterfield, D. *See* Lovering, J. F. 06434

06317 **Byerlee, J. D.** Static and kinetic friction of granite at high normal stress: Internat. Jour. Rock Mechanics and Mining Sci., v. 7, no. 6, p. 577-582, illus., 1970.

Frictional sliding on ground surfaces of granite, angle of sliding planes 30° and 45°, was investigated as a function of confining pressure. Over the normal stress range of 2-12 kb, the static frictional shear stress θ^s follows the relationship $0.5 + 0.6\ \sigma_n$ and the kinetic frictional shear stress θ^k was calculated to be $0.5 + 0.47\ \sigma_n$ [σ^s_n = normal stress across surfaces]. — *from* Author's abstract

06084 **Cacchione, David A.; Southard, John B.** Incipient motion of oceanic bottom sediment by internal gravity waves [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 513, 1970.

Callender, Edward. *See* Bowser, Carl J. 06070

06085 **Callender, Edward; Rossmann, Ronald.** Sedimentary geochemistry of Green Bay, Lake Michigan [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 513-514, 1970.

Calvert, Ronald H. *See* Braddock, William A. 06415

06086 **Cambray, F. William.** Early Tertiary sedimentation and structure in the Wagwater trough, Jamaica, W. I. [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 514, 1970.

05821 **Cameron, A. R.; Birmingham, T. F.** Radioactivity in western Canadian coals: Canada Geol. Survey Paper 70-52, 35 p., illus., tables, 1970.

Significant concentrations of uranium have been found in Cretaceous and younger coals and carbonaceous shales in the midwestern United States. This report presents field and laboratory data obtained during a study of lignite and other Tertiary coals of western Canada. The Cypress Hills area of Saskatchewan holds the best promise for commercial concentrations of uranium. [Field work consisted of measuring radioactivity of coal and carbonaceous beds by scintillometer; in the laboratory samples were analyzed by the end-window Beta method and fluorometric determination.] — Authors' abstract

06178 **Cameron, Cornelia C.** Peat resources of the unglaciated uplands along the Allegheny structural front in West Virginia, Maryland, and Pennsylvania, *in* Geological Survey research 1970, Chap. D: U.S. Geol. Survey Prof. Paper 700-D, p. D153-D161, illus., 1970.

An estimated 634,000 short tons of commercial quality air-dried peat, an amount slightly exceeding half the national annual consumption, was located in the unglaciated uplands along the Allegheny structural front in West Virginia, Maryland, and Pennsylvania. The largest deposits are in Canaan Valley, W. Va. Peat deposits of

the filled-basin type, restricted to terraces, divides, or interfluves in large structurally controlled valleys, are potential resources. The classification standard based on geologic parameters developed and adopted by the American Society for Testing and Materials in 1969 is used in evaluating peat quality. Classification factors such as percentage of ash and percentage of fibers longer than 0.15 mm determine usefulness of peat types as soil conditioners and horticultural materials. — Author's abstract

Cameron, Maryellen. *See* Carman, Max F. 06088

05984 **Camp, Frederick W.** The tar sands of Alberta, Canada: [Denver, Colo.] Cameron Engineers, 78 p., illus., tables, 1970.

A deposit of tar sands containing more than 700 billion bbls of bitumen extends along the Athabasca River for 100 mi north of Fort McMurray in northeastern Alberta. The McMurray Formation of Cretaceous age consists of sand cross-bedded in places with clay and shale lenses and, where impregnated with bitumen, containing tar sands. The deposit averages 150 feet in thickness, with a maximum of 300 feet. About 10 percent of the deposit is mineable by current open-pit methods. About 30 percent is unfeasible for mining due to an economic lower limit of bitumen saturation. Pilot plants at the deposit manufacture some synthetic crude oil. Properties of the tar sands and possible recovery and processing methods are discussed. — EH

Campbell, M. J. *See* Gold, T. 06278

00025 **Canada Geological Survey.** Report of activities — Pt. A, April to October, 1970: Canada Geol. Survey Paper 71-1, pt. A, 259 p., illus., 1971.

This report, containing 132 short papers, some illustrated by page-size maps and figures, presents the preliminary results of field work [on Appalachian geology, coal research, Cordilleran geology, exploration geophysics, geochemistry, geochronology, mineral deposits, paleontology and biostratigraphy, petrology, Precambrian geology, Quaternary geology, Quaternary geochronology and paleontology, Quaternary geophysics, Quaternary sedimentology and geomorphology, stratigraphy, general (mineral collecting and collections), and addendum (continental slope near Vancouver Island)] carried out under the auspices of the Geological Survey of Canada between April and October 1970. — Author's abstract

05985 **Canada Geological Survey.** Geological maps published by the Geological Survey of Canada — Index sheet 35, Quebec-District of Franklin-District of Keewatin: Ottawa, Ontario, Geol. Survey Canada, scale 1:1,000,000, 1970.

05986 **Canada Geological Survey.** Geological maps published by the Geological Survey of Canada — Index sheet 75, District of Mackenzie: Ottawa, Ontario, Geol. Survey Canada, scale 1:1,000,000, 1970.

06193 **Canada Geological Survey.** Aeromagnetic series, Gowganda, Timiskaming District, Ontario: Canada Geol. Survey Geophysics Paper 284 (revised), scale 1:63,360, 1970; originally published 1956.

06194 **Canada Geological Survey.** Aeromagnetic series, Shinning Tree, Sudbury and Timiskaming Districts, Ontario: Canada Geol. Survey Geophysics Paper 285 (revised), scale 1:63,360, 1970; originally published 1957.

06195 **Canada Geological Survey.** Aeromagnetic series, Sinclair Lake, Sudbury and Timiskaming Districts, Ontario: Canada Geol. Survey Geophysics Paper 286 (revised), scale 1:63,360, 1970; originally published 1957.

06196 **Canada Geological Survey.** Aeromagnetic series, Matachewan, Timiskaming District, Ontario: Canada Geol. Survey Geophysics Paper 287 (revised), scale 1:63,360, 1970; originally published 1956.

06197 **Canada Geological Survey.** Aeromagnetic series, Kirkland Lake, Timiskaming District, Ontario: Canada Geol. Survey Geophysics Paper 289 (revised), scale 1:63,360, 1970; originally published 1956.

06198 **Canada Geological Survey.** Aeromagnetic series, Radisson Lake, Timiskaming District, Ontario: Canada Geol. Survey Geophysics Paper 290 (revised), scale 1:63,360, 1970; originally published 1956.

06199 **Canada Geological Survey.** Aeromagnetic series, Peterlong Lake, Sudbury and Timiskaming Districts, Ontario: Canada Geol. Survey Geophysics Paper 291 (revised), scale 1:63,360, 1970; originally published 1956.

06200 **Canada Geological Survey.** Aeromagnetic series, Timmins, Cochrane and Timiskaming Districts, Ontario: Canada Geol. Survey Geophysics Paper 293 (revised), scale 1:63,360, 1970; originally published 1956.

06201 **Canada Geological Survey.** Aeromagnetic series, Watabeag River, Cochrane and Timiskaming Districts, Ontario: Canada Geol. Survey Geophysics Paper 294 (revised), scale 1:63,360, 1970; originally published 19556.

06202 **Canada Geological Survey.** Aeromagnetic series, Ramore, Cochrane and Timiskaming Districts, Ontario: Canada Geol. Survey Geophysics Paper 295 (revised), scale 1:63,360, 1970; originally published 1956.

06203 **Canada Geological Survey.** Aeromagnetic series, Matheson, Cochrane District, Ontario: Canada Geol. Survey Geophysics Paper 296 (revised), scale 1:63,360, 1970; originally published 1956.

06204 **Canada Geological Survey.** Aeromagnetic series, Porquis Junction, Cochrane District, Ontario: Canada Geol. Survey Geophysics Paper 297 (revised), scale 1:63,360, 1970; originally published 1956.

06205 **Canada Geological Survey.** Aeromagnetic series, Pamour, Cochrane District, Ontario: Canada Geol. Survey Geophysics Paper 298 (revised), scale 1:63,360, 1970; originally published 1956.

06087 **Cannon, Helen L.** Lithium in sediments and plants of the Basin and Range Province [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 514-515, 1970.

Cannon, P. J. *See* Rowan, L. C. 05960

Cannon, P. J. *See* Rowan, L. C. 06236

06420 **Card, K. D.; Palonen, P.; Siemiatkowska, K.** Eden Township and parts of Bevin and Caen Townships, Louise-Eden area, District of Sudbury: Ontario Dept. Mines and Northern Affairs Prelim. Geol. Map P. 612, scale 1 in. to 1/4 mi., text, 1970.

The Louise-Eden area is located in the Southern Province of the Canadian Shield, immediately north of the Grenville Front; all rocks are of Middle Precambrian age. In the western section, the main tectonic elements, including faults, fold axes, foliations, and lineations, trend about east-west; to the east they trend northeast parallel to the Grenville Front. Gold has been found in the area; building stone is present, but rather inaccessible; and of several gravel deposits, one is being worked. — MCM

06421 **Card, K. D.; Palonen, P.; Siemiatkowska, K.; Masson, S.** Dunlop Township, District of Sudbury: Ontario Dept. Mines and Northern Affairs Prelim. Geol. Map P. 613, scale 1 in. to 1/4 mi., text, 1970.

The text is the same as for Shakespeare Township (Card, 1970).

06422 **Card, K. D.; Palonen, P.; Siemiatkowska, K.; Masson, S.** Shakespeare Township, District of Sudbury: Ontario Dept. Mines and Northern Affairs Prelim. Geol. Map P. 614, scale 1 in. to 1/4 mi., text, 1970.

Shakespeare and Dunlop Townships are located at the contact between the Southern and Superior Provinces of the Canadian Shield. Major structural elements are northeast-trending faults and folds. Copper, nickel, gold, and uranium mineralization occurs in the Nipissing-type metagabbro and in the Huronian rocks. — MCM

06410 **Carder, D. S.; Qamar, Anthony; McEvilly, T. V.** Trans-California seismic profile — Pahute Mesa to San Francisco Bay: Seismol. Soc. America Bull., v. 60, no. 6, p. 1829-1846, illus., tables, 1970.

Seismic waves were recorded along a profile from the Nevada Test Site to San Francisco Bay, using four high-yield underground nuclear explosions at Pahute Mesa, Nev. In general, Pn traveltimes along the profile can be expressed by the equation $t = (6.2 \pm 0.1) + \Delta/(7.88 \pm 0.02)$; deviations under the Central Valley of California probably are due to deep sediments, and under Owens Valley and the White Mountains to thickened crust. If the Sierra Nevada has a root, it has a relatively high velocity. Total thicknesses of the crust under the Central Valley, Pahute Mesa, and the Sierra Nevada are about 30 km, and under Owens Valley and the White Mountains about 35-40 km. For the first time temporary stations in the Central Valley were able to record initial seismic waves from artificial sources above heavy local noise. — DBV

Carmalt, S. W. *See* Armstrong, R. L. 06217

06088 **Carman, Max F.; Cameron, Maryellen.** Crystallization of feldspars in some alkaline rocks from the Big Bend region of Texas [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 515, 1970.

Carrier, David. *See* Fryxell, Roald. 06276

06233 **Carrigy, Maurice A.** Experiments on the angles of repose of granular materials: Sedimentology, v. 14, nos. 3-4, p. 147-158, illus., tables, 1970.

A simple apparatus for measuring angles of repose, based on a rotating drum principle, is described. The critical *angle of repose* a_c is defined as the angle through which a mass of granular material can be rotated before it falls by avalanching, and the *angle of rest* a_R is defined as the inclination of the slope after avalanching has ceased. The angles of repose of several materials with similar surface characteristics increase with departure of the grains from spherical form. For masses of spherical particles, angles of repose increase with increasing intergranular friction caused by changes in surface characteristics of spheres. It is concluded that shape and surface characteristics of the particles have the greatest effect on angles of repose. — *from* Author's summary

06151 **Carroll, Dorothy.** Rock weathering: New York and London, Plenum Press, 203 p., illus., tables, 1970.

Part of the material in this textbook was originally a series of lectures for agricultural students and later, geology students. The book endeavors to bring together results of research from several disciplines to explain the fundamental geochemical principles of weathering and soil formation; descriptions of processes and results are primarily for igneous rocks. Chapter headings are: Earth's crust, weathering environment, geochemical and pedochemical weathering, soil, soil patterns, amount of chemical weathering, physical weathering, chemical weathering, biological activity in weathering, temperature in weathering, time in weathering, and trace elements in weathering. Appendixes on mineral transformations in weathering and data of rock weathering, a bibliography, and an index are included. — MCM

06332 **Cartmill, John C.; Dickey, Parke A.** Flow of a disperse emulsion of crude oil in water through porous media: Am. Assoc. Petroleum Geologists Bull., v. 54, no. 12, p. 2438-2443, illus., table, 1970.

Emulsions of oil consisting of droplets 1/2 to 1 1/2 microns diameter in concentrations of 20-40 ppm of water were passed from coarse to finer grained mediums. Up to 80 percent of the oil was screened out of the emulsion at the interface. The screening was not the result of capillary effects because the oil droplets were many times smaller than the pores. The oil collected as flocculated, uncoalesced droplets apparently as a result of electrostatic forces. — SEF

06089 **Cartwright, Keros.** Tracing shallow ground-water flow systems by soil temperatures [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 515-516, 1970.

06090 **Castano, John R.; Sparks, Dennis M.** Interpretation of vitrinite reflectance measurements in sedimentary rocks and determination of burial history using vitrinite reflectance and authigenic minerals [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 516-517, 1970.

06185 **Chaffee, M. A.** Determination of acid-soluble and total manganese in geological and botanical materials by atomic absorption, *in* Geological Survey research 1970, Chap. D: U.S. Geol. Survey Prof. Paper 700-D, p. D217-D221, tables, 1970.

A simple, rapid, sensitive atomic-absorption method for determination of acid-soluble and total manganese in geological and botanical materials has been developed. For acid-soluble manganese the sample is digested with hydrochloric or nitric acid, and supernatant liquid atomized in an atomic-absorption spectrophotometer. For total manganese the sample is decomposed by hydrofluoric-perchloric-nitric acid digestion, and resulting residue is taken up in hydrochloric or nitric acid and atomized as in the acid-soluble procedure; hydrochloric acid is preferred to nitric, as it dissolves out more manganese. No interferences have been observed in any routine geochemical samples. Results compare favorably with those obtained from colorimetric or spectrographic methods. A detection limit of 20 ppm has been established, but a lower limit could possibly be obtained. — *from* Author's abstract

05864 **Chamberlain, C. Kent.** Permian trilobite species from central Wyoming and west Texas: Jour. Paleontology, v. 44, no. 6, p. 1049-1054, illus., 1970.

Anisopyge sevilloidia n.sp., a proetid from the Phosphoria Formation, Wyoming, ranges from lower Leonardian through lower Guadalupian, and seems to be intermediate in evolution of the genotype *A. perannulata* (Shumard) from *Sevillia* Weller. Recognition of *Ditomopyge roemeri 0*(Moeller) from the Getaway Limestone, Texas, extends the stratigraphic range of the genus upward to the Guadalupian in North America; the species was previously known only from the Upper Carboniferous of the Urals. A topotype of *A. perannulata* shows inter-ring and ring apodemes. — REG

06091 **Chamberlain, C. Kent.** Vertical succession of trace fossils in the Pennsylvanian-lower Permian of central Utah [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 517, 1970.

Chan, Sunney I. *See* Manatt, Stanley L. 06290

06426 **Chandler, F. W.** McMahon Township, District of Algoma: Ontario Dept. Mines and Northern Affairs Prelim. Geol. Map P. 620, scale 1 in. to 1/4 mi., text, 1970.

The northeastern half of McMahon Township is underlain by Archean granitic rocks; in the northwest granites are mainly porphyritic, and in the east granular. In the southwest corner, mafic volcanic rocks are faulted up against the Gowganda Formation. Thin sandy tills cover much of the area; crossbedded gravels, sands, and varved clays occupy river valleys. Although the overall dip of Huronian rocks is moderate and toward the south or southwest, a combination of Archean and present topography and relatively gentle dip has produced an outcrop distribution complicated by outliers, inliers, and sinuous boundaries. Sandstones in the Matinenda and Gowganda Formations contain disseminated pyrite, and there is some copper mineralization. — MCM

06468 **Chandler, F. W.** Morin Township, District of Algoma: Ontario Dept. Mines and Northern Affairs Prelim. Geol. Map P. 621, scale 1 in. to 1/4 mi., text, 1970.

The northern and greater part of Morin Township is underlain by Archean granitic rocks. Huronian sedimentary rocks rest nonconformably upon the dissected and weathered Archean surface in the southern section and occur as outliers in the northern and eastern parts. A considerable part of the township is covered by thin deposits of sandy till. Archean and present topography have produced an outcrop distribution complicated by outliers, inliers, and sinuous boundaries; faulting has affected the area to a minor extent. Only minor amounts of mineralization have been found. — MCM

06092 **Chang, Luke L. Y.** Subsolidus phase relations in ternary systems of aragonite-type carbonates [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 517-518, 1970.

05843 **Chapman, C. H.; Phinney, R. A.** Diffraction of P waves by the core and an inhomogeneous mantle: Royal Astron. Soc. Geophys. Jour., v. 21, no. 2, p. 185-205, illus., 1970.

The theory of diffraction of elastic waves by a spherical interface is extended to an inhomogeneous velocity structure. The decay constant for P waves in the core shadow is evaluated numerically for several possible models of the Bullen region D0 and the behavior compared with the asymptotic theory. The spectral amplitudes across the core shadow boundary of two of these models are presented. These theoretical and numerical methods allow spectral amplitudes for a wide frequency range to be interpreted. — Authors' summary

06093 **Chase, R. L.; Barr, S.; Thomlinson, A. G.** Deformation revealed by CSP on margins of the northern sector of Juan de Fuca lithospheric plate, northeast Pacific Ocean [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 518-519, 1970.

Chatelain, A. *See* Weeks, R. A. 06300

06094 **Chaudhuri, S.; Brookins, Douglas G.; Twiss, Page C.; Spooner, Charles M.** The effect of acid-leaching process on the strontium isotopic composition of sedimentary rocks [abs]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 518-519, 1970.

06095 **Chave, Keith E.** Carbonate-organic interactions in the oceans [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 519, 1970.

06439 **Chemekov, Yu. F.** Problema drevnikh oledeneniy i pliotsen-chetvertichnoy granitsy v svete absolyutnoy geokhronologii [The problem of old glaciations and the Pliocene-Quaternary boundary in the light of absolute geochronology]: Akad. Nauk SSSR Izv. Ser. Geol. 1970, no. 9, p. 110-116, 1970.

Traces of glaciation about 3 m.y. old (according to K-Ar dating) have been discovered in the Sierra Nevada range of the United States, the same age as the oldest tillites of Iceland. Traces of late Pliocene glaciation are found in the Caucasus. The first glaciomarine deposits in the Antarctic Ocean have been dated as about 2.5 m.y., at the boundary of the Gauss and Matuyama paleomagnetic epochs. New Zealand tillites have been dated as 2.5 m.y. by the K-Ar method. Absolute age data indicate at least four major planetary cold waves with boundaries at about 1.0, 1.5-1.7, 2.5, and 3.0 m.y. ago. As one of these boundaries corresponds to the Plio-Pleistocene boundary, they should be studied using all possible criteria. — DBV

Chen, Kuan-Lin. *See* Konrad, John G. 06373

Chesters, Gordon. *See* Konrad, John G. 06373

06389 **Chiang, S. L.; Petersen, G. W.** Soil catena concept for hydrologic interpretations: Jour. Soil and Water Conserv., v. 25, no. 6, p. 225-227, tables, 1970.

Understanding the relationship between soil characteristics and the behavior of runoff water is requisite to improved soil and water conservation. To effectively convey hydrologic soils information from soil scientists to nonsoil scientists, an ideal soil catena diagram is proposed. This diagram relates parent material, texture, drainage, depth and, to some extent, the subsurface conditions of the soil. — Authors' abstract

06096 **Chipping, David H.** High density grain flows in flysch deposits [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 519-520, 1970.

06097 **Christ, C. L.** Some contributions of crystal chemistry to geology [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 520, 1970.

06354 **Christiansen, Earl A.** (editor). Physical environment of Saskatoon, Canada: Natl. Research Council Canada Pub. 11378, 68 p., illus., geol. maps, 1970.

A study by the Saskatchewan Research Council of the urban geology of Saskatoon broadened from its initial coverage of an area with a radius of 5 mi of the city center to consider the entire physical environment of an area of 1250 sq mi with a radius of 20 mi. This folio deals with physical aspects of geology, hydrology, and meteorology and the relation of the physical environment to geothechnical development. Both available data and information procured especially for this investigation are presented, primarily in maps and illustrations. Six papers are cited individually. — GDC

06355 **Christiansen, Earl A.** Geology, *in* Physical environment of Saskatoon, Canada: Natl. Research Council Canada Pub. 11378, p. 3-17, illus., geol. maps, 1970.

Mapped are the Lea Park Formation-Upper Colorado Group, Oldman and Bearpaw formations of Cretaceous age; bedrock surface reflects preglacial, fluvio-glacial, and glacial erosion, modified by collapse from ground-water solution of Devonian salt in the thick Prairie Evaporite Formation, and by subsidence faults. Surficial deposits and moraines comprise the Empress Group of stratified drift, the Sutherland Group of clayey tills and stratified drift, and the Saskatoon Group of sandier tills and more dolomitic stratified drift (the Floral and Battleford Formations). Figured are textures and X-ray diffraction patterns, as well as geologic maps and cross-sections. Four glaciations are indicated, with the last retreat 12,000 years ago with over 300 feet of collapse during Battleford deposition. Phases of Glacial Lake Saskatoon ended with wind-blown silt. — GDC

06357 **Christiansen, Earl A.; Meneley, W. A.** Slope stability, *in* Physical environment of Saskatoon, Canada: Natl. Research Council Canada Pub. 11378, p. 51-52, illus., 1970.

Caving, sliding, and piping are major types of slope failure. Contorted lake beds, glacially deformed sediments, and weathered deposits are susceptible to caving. In the lower part of Saskatoon's surficial stratified drift, the sand, silt, and clay are highly contorted, fractured, and slickensided, and cave readily when excavated. Glacially deformed till is highly fractured, with nutty structure; that weathered in the upper Sutherland Group has clods covered by "clay-skins" which further weaken the sediments. On the South Saskatchewan River near 25th Street, where drift is over 50 feet thick, landslides are restricted to the continually undercut east bank; the west bank has been naturally stabilized. In dry silt and clay, slip is rotational with little flow; when wet, the failure combines slip and flow. Piping, or erosion by seepage, in Petursson's Ravine, started when the river exposed the Forestry Farm Aquifer. — GDC

06359 **Christiansen, Earl A.** Sand and gravel resources, *in* Physical environment of Saskatoon, Canada: Natl. Research Council Canada Pub. 11378, p. 56, illus., 1970.

Although no attempt was made to investigate sand and gravel deposits in the Saskatoon area, geologic and pedologic information presented herein provide a rational basis for exploring them. Deposits occur between till and surfacial stratified drift, between tills, and between till and bedrock; they grade from ice-contact kames, kame moraines, and eskers to outwash deposits. Those of the Empress Group in the Tynor Valley and its tributaries, and between tills of the Sutherland Group and in its upper part, are too deeply buried to be of commercial importance. For this study, only sand deposits of medium grain or coarser are considered to be of commercial importance; and maximum allowable depth of overburden is assumed to be 25 feet. Restricted to specific positions in the Battleford Formation, the most favorable areas for exploration are shown on small maps. — GDC

06443 **Christodoulides, Costas; Durrani, Saeed A.; Ettinger, Kamil V.** Study of thermoluminescence in some stony meteorites: Modern Geology, v. 1, no. 4, p. 247-259, illus., tables, 1970.

Thermoluminescence in five stony meteorites — Allende, Barwell, Brownfield, Dresden, and Gruver — has been studied as a possible method of dating. Similarities are observed in glow-peak temperatures of all five, suggesting presence of common phosphors and/or activators. On irradiating the meteorites with γ-rays, up to 11 distinguishable peaks are reproduced. By examining variation of the glow areas under peaks at high-temperature intervals, the γ-ray equivalent natural doses have been determined, and are used to place upper limits on ages of Allende, Barwell, and Brownfield, which would result if natural doses had originated exclusively from internal radioactivity. The shielding effect of cosmic rays within the meteorite, as well as their relative TL efficiency is stressed. Reasons for the low ages found, compared to primordial planetary material, are advanced. — *from* Authors' abstract

Chung, D. H. *See* Kanamori, Hiroo. 06288

06350 **Chung, D. H.; Westphal, W. B.; Simmons, Gene.** Dielectric properties of Apollo 11 lunar samples and their comparison with Earth materials: Jour. Geophys. Research, v. 75, no. 32, p. 6524-6531, illus., tables, 1970.

Values of dielectric permittivity, dissipation factor, and electrical conductivity in the 100 hz-10 Mhz frequency range and -196°C to + 200°C temperature range are presented for Apollo 11 samples 10020, 10057, and 10046. Values obtained are compared with those for terrestrial basalt and a simulated lunar material with the composition of Surveyor 5 results. The lunar samples have higher values of dielectric constant than terrestrial basalts. The high-frequency dielectric constant of lunar igneous samples is about 9 to 15, of breccia about 6 to 9. The dielectric losses are also greater in lunar than in terrestrial samples and in lunar igneous rock than in lunar breccias. Conductivity values in the lunar samples range from 10^{-9} to 10^{-11} $(ohm\text{-}cm)^{-1}$ and in igneous rock depend more strongly on temperature than in breccia. All lunar samples show a temperature-dependent, low-frequency dispersion. — DBV

Chung, Yu-Chia. *See* Broecker, Wallace. 06405

06098 **Cisne, John L.** Feeding and trail production in a trinucleid trilobite [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 520, 1970.

06362 **Cita, Maria Bianca.** Observations sur quelques aspects paléoécologiques de sondages suboceaniques effectués dans l'Atlantique nord [Observations on some paleoecological aspects of deep-sea borings in the North Atlantic]: Rev. Micropaléontologie, v. 12, no. 4, p. 187-201, illus., 1970.

As part of the Deep Sea Drilling Project, sediment cores were collected from five sites in the North Atlantic on Leg 2 (New York-Dakar) of cruises of the 0*Glomar Challenger*; the borings penetrated an undisturbed Pleistocene-Upper Cretaceous sequence. Planktonic foraminiferal assemblages in the sediments seem to be controlled by carbonate solution according to depth. Present data indicate that either the sedimentation depth has varied during geologic time or the carbonate compensation depth has changed; variations have been observed particularly in the Upper Cretaceous, Eocene, and Pliocene. Signs of dissolution in foraminifer tests are corrosion of exterior, enlargement of pores, destruction of inner chambers, fragmentation; dissolution is selective by species, size, other factors. Calcareous nannoplankton seem to be less easily dissolved. — VMJ

06099 **Clark, George R., 2d.** Daily growth ridge accretion in the scallop *Pecten diegensis* [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 521-522, 1970.

Clark, J. R. *See* Coleman, R. G. 05895

05884 **Clark, John H.** Geology of the carbonate rocks in western Franklin County, Pennsylvania: Pennsylvania Geol. Survey Prog. Rept. 180, 1 sheet, scale 1:24,000, sections, text, 1970.

Bedrock exposed within the Mercersburg area ranges from Middle Cambrian to Upper Ordovician; surficial deposits occur as alluvium in stream valleys. General interpretation of depositional history is that continuous miogeosynclinal sedimentation occurred principally in a stable, shallow, open-marine sea until Middle Ordovician when conditions were less stable and seas became deeper. Flexural-slip folding was the primary mode of deformation, although there is evidence also for shear; numerous faults disect the structures. There are six to eight major anticlines and synclines; the dominant features are the NE-trending faults; and there are six major joint systems. — MCM

06403 **Clarke, W. B.; Beg, M. A.; Craig, Harmon.** Excess helium 3 at the North Pacific Geosecs station: Jour. Geophys. Research, v. 75, no. 36, p. 7676-7678, illus., table, 1970.

Helium isotope measurements show that North Pacific deep water contains excess He-3 in amounts similar to the values observed previously in the South Pacific. The maximum ratio anomaly relative to atmospheric He-3/He-4 is 22 percent at 2,000-2,500 meters and decreases to 13 percent at 4,100 meters. — Authors' abstract

06019 **Clausen, George Samuel.** Optimal operation of water-supply systems [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 12, pt. 1, p. 5576B-5577B, 1970.

Clay, C. S. *See* Berkson, J. M. 06157

Clegg, P. E. *See* Bastin, J. A. 06269

05893 **Cloud, Preston.** Adventures in earth history: San Francisco, Calif., W. H. Freeman and Co., 992 p., illus., tables, 1970.

This volume is a collection of papers from original sources on cosmology, geology, climatology, oceanography, organic evolution, and related topics. It is designed to be a source of selected supplemental reading for an introductory course (skipping difficult items) in historical geology, as well as to provide core reading for an advanced course or seminar on problems of earth history at an upper-division undergraduate or beginning graduate level. The 83 papers are grouped in sections under two major headings: (1) principles, processes, and origins (5 sections) and (2) the geologic record (5 sections). — VSN

06318 **Coates, D. F.; Yu, Y. S.** A note on the stress concentrations at the end of a cylindrical hole: Internat. Jour. Rock Mechanics and Mining Sci., v. 7, no. 6, p. 583-588, illus., tables, 1970.

The stress concentrations on the flat end of a cylindrical hole [important in determining field stresses in rocks] have been solved using the finite element method. The concentration factors are dependent on Poisson's ratio according to the following regression equations: $a = 1.366 + 0.025\mu + 0.502\mu^2$; $b = -0.125 + 0.154\mu + 0.390\mu^2$; $c = -0.520 - 1.331\mu + 0.886\mu^2$, where a is the stress concentration factor applied to the field stress in the radial direction, b is the stress concentration factor applied to the field stress in the tangential direction, c is the stress concentration factor applied to the field stress in the axial direction to obtain the radial stress at the center of the flat end of the hole, and μ is Poisson's ratio. — Authors' abstract

06427 **Cobb, Edward H.** (compiler). Antimony occurrences in Alaska: U.S. Geol. Survey Mineral Inv. Resource Map MR-52, scale 1:2,500,000, separate reference list, 1970.

06428 **Cobb, Edward H.** (compiler). Bismuth occurrences in Alaska: U.S. Geol. Survey Mineral Inv. Resource Map MR-53, scale 1:2,500,000, separate reference list, 1970.

06429 **Cobb, Edward H.** (compiler). Mercury occurrences in Alaska: U.S. Geol. Survey Mineral Inv. Resource Map MR-54, scale 1:2,500,000, separate reference list, 1970.

06430 **Cobb, Edward H.** (compiler). Uranium, thorium, and rare-earth elements in Alaska: U.S. Geol. Survey Mineral Inv. Resource Map MR-56, scale 1:2,500,000, separate reference list, 1970.

06169 **Cobban, W. A.** Occurrence of the Late Cretaceous ammonites *Didymoceras stevensoni* (Whitfield) and *Exiteloceras jenneyi* (Whitfield) in Delaware, *in* Geological Survey research 1970, Chap. D: U.S. Geol. Survey Prof. Paper 700-D, p. D71-D76, illus., 1970.

The heteromorphic ammonites, *Didymoceras stevensoni* (Whitfield) and *Exiteloceras jenneyi* (Whitfield), known from many localities in the western interior of the United States, have not been recorded outside that region. *Didymoceras stevensoni* is a helical ammonite easily identified from fragments by sparse ribbing and an impressed area on one or two whorls. *Exiteloceras jenneyi* is loosely coiled in a plane with most or all whorls not in contact; this characteristic and the presence of a pair of tubercles on each rib readily identify fragments of this species. Recently five fragments of heteromorphs referable to these species were found as float near the east end of the Chesapeake and Delaware Canal in New Castle County, Del. Fragments of *D. stevensoni* are possibly from the Marshalltown Formation, and pieces of *E. jenneyi* may be from the Mount Laurel Sand. — *from* Author's abstract

06100 **Coffman, Daniel M.; Melhorn, Wilton N.** Division ratio, a new parameter in stream analysis [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 522-523, 1970.

05953 **Cohee, George V.** Memorial of Hugh Dinsmore Miser — December 18, 1884-August 1, 1969: Am. Mineralogist, v. 55, nos. 3-4, p. 583-591, portrait, 1970.

Cohen, Lewis H. *See* Adams, Herbert G. 06038

06191 **Cohen, Philip; Kimmel, G. E.** Status of salt-water encroachment in 1969 in southern Nassau and southeastern Queens Counties, Long Island, New York, *in* Geological Survey research 1970, Chap. D: U.S. Geol. Survey Prof. Paper 700-D, p. D281-D286, illus., tables, 1970.

Chloride data obtained from "outpost" wells and other wells in southern Nassau and southeastern Queens Counties, indicate that landward movement of a deep wedge of salty ground water in the area has been minimal from 1960-69. Significant changes in chloride content were noted in only 3 of 30 outpost wells. Chloride content of water from a well in southeastern Queens County increased from 34 mg/*l* in 1960 to 112mg/*l* in 1969, as a result of intensive ground-water withdrawals in that county; chloride content in two wells in Nassau County increased from 8,520-11,000 mg/*l* and from 2,000-8,110 mg/*l* during the same period. These increases resulted from local heavy pumping near the zone of diffusion. No increase in chloride content was noted in water from the Lloyd aquifer, except where leaky casings permitted downward flow of salty water. — *from* Authors' abstract

Cole, T. J. S. *See* Shafiqullah, M. 06115

06101 **Coleman, Leslie C.** Kenoran orogeny in the Churchill province of the Canadian shield [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 523-524, 1970.

05895 **Coleman, R. G.; Clark, J. R.** Pirokseny v goluboslantsevoy fatsii Kalifornii [Pyroxenes in the blueschist facies of California (with English abs.)], *in* Problemy petrologii i geneticheskoy mineralogii, V. 2: Moscow, Akad. Nauk SSSR Sibir. Otdeleniye (Izdatel'stvo "Nauka"), p. 41-53, illus., tables, 1970.

Blueschist metamorphism of the Franciscan Formation has produced pyroxenes characteristically related to host rock. Pure end-member jadeite is restricted to metasomatized leucocratic masses within serpentinite; jadeitic pyroxene coexists with quartz in metagraywackes; omphacite or acmitic pyroxene are present in metabasalts; and metacherts are characterized by acmitic pyroxenes only. Chemical, optical, and X-ray parameters of pyroxenes from representative rocks demonstrate strong variations related to rock composition. Experimental work indicates that at P-T conditions of blueschist metamorphism, jadeite and related pyroxenes are favored by high pressure. Contemporaneous metamorphism demands a similar P-T environment for pyroxenes from different rock types; in silica-deficient environment of serpentinites pure jadeites form; in other rocks with excess silica, jadeitic pyroxene and omphacite are stable. — *from* Authors' English abstract

06102 **Collins, Desmond.** The microstructure and function of the connecting ring of *Nautilus*, *Spirula* and fossil nautiloids [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 524, 1970.

Collinson, D. W. *See* Runcorn, S. K. 06292

05900 **Colmet-Daage, F.; Gautheyrou J.; Gautheyrou, M.; deKimpe, C.; Sieffermann, G.; Delaune, M.; Fusil, G.** Caractéristiques de quelques sols derivés de cendres volcaniques de la cote pacifique du Nicaragua [Characteristics of some soils derived from volcanic ash from the Pacific coast of Nicaragua (with German and English abs.)]: [France] Office Recherche Sci. et Tech. Outre-Mer Cahiers, Sér. Pedologie, v. 8, no. 2, p. 113-169, illus., tables, 1970.

Soils developed on volcanic ash from the Pacific coast of Nicaragua were compared with similar soils from the French West Indies and Ecuador. Clayey soils with halloysite were similar for all three regions, but young soils containing only a little clay differed noticeably. Hydrated allophanic soils from Nicaragua have a higher water-retention capacity than those from the other areas. Relatively high cation-exchange capacity may be due to the long dry season. Red soils on volcanic ash occur only in Nicaragua. Principal factors governing their formation are a relatively dry climate, flat topography which inhibits erosion, sparse vegetation and strong insolation. — *from* Authors' abstract

Colquhoun, D. J. *See* Pierce, J. W. 05966

Condrate, R. A., Sr. *See* Levitt, S. R. 05946

06103 **Connally, G. Gordon; Sirkin, Leslie A.** The Wisconsinan history of the Hudson-Champlain lobe [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 524-525, 1970.

06165 **Connor, J. J.; Trace, R. D.** Outlier of Caseyville Sandstone near Princeton, Kentucky, may be Bethel Sandstone, *in* Geological Survey research 1970, Chap. D: U.S. Geol. Survey Prof. Paper 700-D, p. D33-D35, illus., 1970.

Geochemical studies indicate that an isolated outcrop mapped as Caseyville Sandstone (Lower Pennsylvanian) near Princeton, Ky., is more closely allied in its composition to sandstones of Mississippian age. Recent regional geologic studies suggest that it may in fact be part of the Bethel Sandstone of Late Mississippian age. — Authors' abstract

05846 **Cook, A. H.** Geodesy, *in* Global geophysics: New York, American Elsevier Publishing Company, p. 27-66, illus., table, 1970.

The figure of the Earth as a solid rotating body with a powerful gravitational field is discussed. Emphasis is on modern developments of methods for measurement of distance based on traveltime of electromagnetic waves, the theory of the shape of external equipotential surfaces, modern methods of gravity measurement, and derivation of the gravitational potential of the Earth from orbits of artificial satellites. Following an introduction, chapters within this section discuss theory of the external gravity field of the Earth, modern survey methods (electromagnetic with Tellurometer, Geodimeter, Mekometer) and geometric observations with artificial satellites. — VSN

06340 **Cook, David O.** The occurrence and geologic work of rip currents off southern California: Marine Geology, v. 9, no. 3, p. 173-186, illus., table, 1970.

An investigation of the occurrence of rip currents in southern California revealed that the development of these features is influenced by wave conditions, beach morphology, tidal level, and wind. The largest rips are formed during periods of intense wave activity. A study of sedimentation by rip currents was performed at Redondo Beach. The currents selectively remove fine sand and minerals with low specific gravity from the beach. Large rips transport significant quantities of sediment to the inner continental shelf. Rip current channel deposits are sedimentary structures which may aid in reconstructing paleoshorelines. — Author's abstract

06148 **Coombs, Howard A.** Geologic problems in raising Ross Dam, Skagit River, Washington [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 526, 1970.

06104 **Copeland, Richard A.** Selenium and mercury distribution in Lake Michigan invertebrates [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 526, 1970.

05913 **Cordoba, Diego A.; Rodriguez-Torres, Rafael; Guerrero-Garcia, Jose.** Mesozoic stratigraphy of the northern portion of the Chihuahua Trough [abs.], *in* The geologic framework of the Chihuahua tectonic belt — Symposium in honor of Ronald K. De Ford, Midland, Tex., 1970: Midland, Tex., West Texas Geol. Soc., p. 40-41, 1970.

05825 **Cordova, R. M.** Ground-water conditions in southern Utah Valley and Goshen Valley, Utah: Utah Dept. Nat. Resources Tech. Pub. 28, 74 p., illus., tables, 1970.

Unconsolidated deposits filling southern Utah and Goshen Valleys to unknown depths include a water-table and three artesian aquifers. Water needs are supplied by surface water, and wells, drains, and springs in the valley fill. Water-level records indicate long-term discharge and recharge are in equilibrium in southern Utah Valley, but in Goshen Valley annual discharge exceeds annual recharge and water is being withdrawn from storage in the aquifer. Amount of recoverable water in storage in the upper 400 feet of saturated valley fill is estimated at 3 million acre-feet in each valley. Yields of wells range from less than 1 to 4,000 gpm; averages are about 40 gpm and 16 gpm for the two valleys for wells with diameters 8 inches or less, about 1,200 and 1,500 gpm for larger wells. Average concentration of dissolved solids is greater in Goshen Valley than in southern Utah Valley. — *from* Author's abstract

Corman, D. B. *See* Sheridan, R. E. 00010

05870 **Corneliussen, Eric F.; Perry, T. G.** The ectoproct *Batostoma? cornula* (Cumings and Galloway) and its enigmatic intrazooecial spines [Fort Atkinson Limestone (Cincinnatian), Wilmington, Illinois]: Jour. Paleontology, v. 44, no. 6, p. 997-1008, illus., tables, 1970.

This trepostomatous bryozoan species is completely reexamined and redescribed qualitatively and quantitatively. Comparison of Cumings and Galloway's specimens, which they had referred to *Nicholsonella* Ulrich, with the primary types of *N. ponderosa* (type species) necessitated generic reassignment of their specimens. *B., cornula* may represent an evolutionary stage of development between *Batostoma* Ulrich and *Trematopora* Hall or a form intermediate between earlier and later species of a single, more embracive genus. Intrazooecial spines are common in this species and relatively so in other genera; photomicrographs of *B., cornula* show zooecial wall laminae inflecting into the intrazooecial spines, a condition strongly suggesting that the spines are parts of the ectoproct rather than algal or fungal symbionts. — *from* Authors' abstract

06272 **Costes, N. C.; Mitchell, J. K.** Apollo 11 soil mechanics investigation, *in* Apollo 11 Lunar Sci. Conf., Houston, Tex., 1970, Proc. — V. 3, Physical properties: New York, and Oxford, England, Pergamon Press (Geochim. et Cosmochim. Acta Supp. 1), p. 2025-2044, illus., tables, 1970.

The fine-grained surface material at the Apollo 11 landing site is a brownish, medium-gray slightly cohesive granular soil, with bulky grains in the silt-to-fine-sand range, having a specific gravity of 3.1 and exhibiting adhesive characteristics. Within the upper few centimeters, the lunar soil has an average density of about 1.6 g per cubic centimeter and is similar in appearance and behavior to the soils studied at the Surveyor equatorial landing sites, for which the cohesion had been estimated to be in the order of $7/10^{-2}$ N/cm^2 and the angle of internal friction to be in the range of 35°-39° for normal stresses of a few N/cm^2. Although considerably different in composition and in range of particle shapes, it is similar in its mechanical behavior to granular, slightly cohesive terrestrial soils of the same grain size distribution and same packing characteristics. — Authors' abstract

Cox, Allan. *See* Doell, Richard R. 00019

Craddock, Campbell. *See* Mooney, Harold M. 05876

06399 **Craig, H.; Weiss, R. F.** The Geosecs 1969 intercalibration station — Introduction, hydrographic features, and total CO_2-O_2 relationships: Jour. Geophys. Research, v. 75, no. 36, p. 7641-7647, illus., tables, 1970.

The temperature, salinity, dissolved oxygen, and shipboard chromatograph ΣCO_2 data from the 1969 Geosecs station are summarized. Vertical diffusion-advection model parameters calculated from the ΣCO_2 and O_2 data, by using the mixing parameters obtained from temperature and salinity, give approximately equal mean to CO_2 production and O_2 consumption rates over the deep-water column. — Authors' abstract

Craig, Harmon. *See* Clarke, W. B. 06403

Craig, Harmon. *See* Broecker, Wallace. 06405

05789 **Cramer, Fritz H.** Acritarchs and chitinozoans from the Silurian Ross Brook Formation, Nova Scotia: Jour. Geology, v. 78, no. 6, p. 745-749, illus., table, 1970.

Upper Llandoverian shales from the Ross Brook Formation at Arisaig Beach, Nova Scotia, have abundant acritarchs and chitinozoans, scolecodonts, graptolite fragments, and *Tasmanites* spp. The assemblages are placed in the *Domasia* phytoplankton facies, and are correlated with the Rose Hill Formation of Pennsylvania and the late Llandoverian of the Belgian Ardennes. — *from* Author's abstract

Cremers, C. J. *See* Birkebak, R. C. 06270

06273 **Cremers, C. J.; Birkebak, R. C.; Dawson, J. P.** Thermal conductivity of fines from Apollo 11, *in* Apollo 11 Lunar Sci. Conf., Houston, Tex., 1970, Proc. — V. 3, Physical properties: New York, and Oxford, England, Pergamon Press (Geochim. et Cosmochim. Acta Supp. 1), p. 2045-2050, illus., table, 1970.

The thermal conductivity of the fines from the Apollo 11 flight (sample 10084-68) was measured under vacuum conditions using the line heat source technique. It was found to vary from about 1.44×10^{-3} w/m-°K at 200°K to 2.47×10^{-3} w/m-°K at 400°K. — Authors' abstract

05831 **Crew, M. E.; Berkoff, E. W.** TWO PIT, a different approach to calibration of gamma-ray logging equipment: Log Analyst, v. 11, no. 6, p. 26-32, illus., tables, 1970.

A method of calibrating gamma-ray logging equipment using a computer to determine apparent dead time and a K-factor is described. Input to the computer are the value of the GT (grade-thickness product) derived from logs of two test pits with different grades and GT's, and a series of observed counts taken at equal intervals between backgrounds in each pit. A Fortran program for IBM 1401 and 1130 computers is adaptable to similar computers. This method produces a dead time type correction for several combined effects, not true instrumental dead time. Its advantages are determination of dead time type effects, based on counting geometry and count rates similar to those encountered in field logging, and calibration based on a high- and low-grade pit. — *from* Authors' abstract

05820 **Crowl, G. H.; Frankel, L.** Surficial geology of Rustico map-area, Prince Edward Island (11 L/6): Canada Geol. Survey Paper 70-39, 15 p., illus., geol. map, 1970.

During the last Pleistocene glaciation, Rustico map-area was covered by ice from New Brunswick which moved east-southeast. Later, ice flowed eastward along Northumberland Strait; some may have been diverted northeastward into the southern part of the map-area and into Hillsborough Bay or else was from the island south and southwest towards the Strait. Till, composed of ice-deposited ground moraine covering much of the area, varies in physical characteristics locally and, except for sparse erratic boulders, contains only material ascribed to local bedrock sources. Absence of end moraines and large proglacial deposits, and presence of an anastomosing complex of ice-contact stratified drift over large parts of the eastern two-thirds of the area suggest that deglaciation occurred by down-melting of a rapidly thinning, stagnant ice mass. — *from* Authors' abstract

Crowley, W. P. *See* Armstrong, R. L. 06217

05827 **Crowley, William.** Introduction, *in* New interpretations of eastern Piedmont geology of Maryland, *or* granite and gabbro or graywacke and greenstone?—35th Ann. Field Conf. Pennsylvania Geologists, 1970, Guidebook: Harrisburg, Pa., Pennsylvania Topog. and Geol. Survey, *also* Baltimore, Md., Maryland Geol. Survey, p. 1-4, illus., 1970.

Illustrated in Cecil County are recent concepts by Higgins; in Harford County, some of Southwick's problems (1969); in Baltimore County, work of Hopson (1944) and earlier geologists on the gabbro complex west of Baltimore and on a variety of igneous and meta-igneous rocks, with emphasis on crystallization history. Probably most important was the stratigraphic sequence worked out by Matthews (1904); a complete section is present in Baltimore County, but only the uppermost part crops out in Cecil County. By the 30's emphasis was on structure, with Ernst Cloos' concepts of small-scale planar and linear features; Broedel's study of Baltimore gneiss domes is a subject of the second day's trip. Relevant to the first day's trip are papers by Hershey on the Port Deposit gneiss complex and synclinal granodiorite, and by Marshall on Cecil County metavolcanics. Hopson's submarine slide interpretation of the "Sykesville Granite" is extended to the Port Deposit Gneiss. — GDC

Crowley, William. *See* Higgins, Michael W. 05828

05829 **Crowley, William; Olsen, Sakl.** Introduction to field trip, second day, and road log, *in* New interpretations of eastern Piedmont geology of Maryland, *or* granite and gabbro or graywacke and greenstone?—35th Ann. Field Conf. Pennsylvania Geologists, 1970, Guidebook: Harrisburg, Pa., Pennsylvania Topog. and Geol. Survey, *also* Baltimore, Md., Maryland Geol. Survey, p. 37-60, illus., 1970.

On this field trip two Baltimore gneiss domes are seen; stratigraphy of the area is shown in columnar section exposed on Towson dome's northwest flank. Minor folds suggest at two stops the possibility of a double deformation, and the curvilinear Towson dome a synformal plunge flopped over to the north. At Gunpowder Falls gas storage site, Olsen reviews description of the Gunpowder Granite intercalated in the Glenarm Series, exposed on the southeast flank of a long neck of Towson dome. An anatectic origin is supported for this granite in sharp contact with similar Baltimore gneiss. A mile across, on opposite flank of the dome, the Gunpowder is absent and the Baltimore Gneiss has a two-fold division. In Wissahickon schist on south flank of Phoenix dome, thin interlayered quartzites outline WSW-plunging dextral folds. — GDC

05914 **Cserna, Zoltan de.** Tectonics of northern Mexico [summ.], *in* The geologic framework of the Chihuahua tectonic belt — Symposium in honor of Ronald K. De Ford, Midland, Tex., 1970: Midland, Tex., West Texas Geol. Soc., p. 42-43, 1970.

06029 **Cserna, Zoltan de.** The Precambrian of Mexico, *in* The geologic systems — The Precambrian, V. 4 (Kalervo Rankama, editor): New York and London, Interscience-John Wiley and Sons, p. 253-270, illus., table, 1970.

Known localities of Precambrian rocks are in the states of Sonora, Tamaulipas, and Oaxaca, and probably in Nuevo Leon and Hidalgo. The granite and metamorphic basement in Caborca and Cabullona, Sonora, appear to be late Early Precambrian in age, whereas metamorphic rocks in the Ciudad Victoria, Tamaulipas, and La Joya and Jaachila, Oaxaca, are of early late Precambrian age. This two-fold division is probably related to tectonics; that is, the Precambrian igneous and metamorphic rocks of Mexico formed during anatexitic (1855-1680 m.y. ago) and taphrogenic (1680 m.y. ago) phases of one geotectonic cycle and during the anatexitic phase (1100-950 m.y. ago) of another, which produced two distinct structural belts. The younger Precambrian rocks of the Caborca area suggest that the North America Cordilleran Paleozoic geosyncline had already formed at the end of Precambrian time. — VSN

06111 **Currie, K. L.** An hypothesis on the origin of alkaline rocks suggested by the tectonic setting of the Monteregian Hills, *in* Alkaline rocks, the Monteregian Hills —

Symposium, Montreal, 1969, Proc.: Canadian Mineralogist, v. 10, pt. 3, p. 411-420, illus., tables, 1970.

Emplacement of Monteregian igneous rocks was controlled by tectonic features at least 1500 miles long and 600 m.y. old. Repeated igneous episodes occurred at roughly 200 m.y. intervals. This persistence is suggested as due to desilication of solid and liquid silicate masses by flux of an aqueous phase through them. Diffusional and flow processes in a continental crust above a rising convection current concentrate water in sufficient amounts to make desilication a significant process. Desilication by vapour flux avoids thermal barriers encountered in other desilication hypotheses either by lowering solidus temperature of the barrier, or by creating masses of solid alkaline rocks to serve as parents for later alkaline igneous rocks. The process is self-stabilizing and tends to lead to extended periods of alkaline igneous activity. Within the mantle it leads to conversion of basaltic magmas into olivine nephelinites, the parent magma of mafic alkaline rocks; within the crust it offers a means by which nepheline syenites and related rocks can be generated by anatexis. — *from* Author's abstract

Custard, H. C. *See* Davis, J. B. 06333

00020 **Cvancara, Alan M.** (and others). Paleolimnology of Late Quaternary deposits — Seibold site, North Dakota: Science, v. 171, no. 3967, p. 172-174, illus., 1971.

A unique late Quaternary lacustrine deposit has been discovered recently on the Missouri Coteau of North Dakota. A diverse, extremely well-preserved biota of more than 160 species has been recovered primarily from an organic mud deposited about 9500 years before the present. The lacustrine body shallowed gradually as the climate became drier. — Authors' abstract

Dachille, Frank. *See* Simons, P. Y. 05938

Dahlem, D. H. *See* Shoemaker, E. M. 06294

06274 **Dalrymple, G. Brent; Doell, Richard R.** Thermoluminescence of lunar samples from Apollo 11, *in* Apollo 11 Lunar Sci. Conf., Houston, Tex., 1970, Proc. — V. 3, Physical properties: New York, and Oxford, England, Pergamon Press (Geochim. et Cosmochim. Acta Supp. 1), p. 2081-2092, illus., 1970.

Appreciable natural thermoluminescence (TL) with glow curve peaks at about 350°C for fines and breccias and above 400°C for crystalline rocks occurs in the Apollo 11 samples. Plagioclase is the principal TL carrier and the difference in peak temperatures indicates that crystalline rocks of the type examined could not have contributed significant amounts of plagioclase to the fines or breccia samples unless the feldspar first underwent chemical or physical changes. The present TL in the Apollo 11 samples is probably the result of a dynamic equilibrium between acquisition from radiation and loss in the lunar thermal environment. The shapes of the glow curves from core samples change progressively with depth, suggesting that TL disequilibrium may be used in lunar stratigraphic studies. The curves also indicate that lunar diurnal temperature variations extend to a depth of at least 10.5 cm. An anomaly in the core tube glow curves between 7.8 and 10.5 cm identified a surface buried by recent lunar surface activity. — Authors' abstract

Daugherty, K. I. *See* Woollard, G. P. 06323

Davies, T. A. *See* Berggren, W. A. 06160

05927 **Davis, Briant L.** Calculation of X-ray diffraction patterns for anisotropic mineral aggregates, *in* Experimental and natural rock deformation — Internat. Symposium, Darmstadt, Germany, 1969, Proc. (P. Paulitsch, editor): Berlin and Heidelberg, Germany, Springer-Verlag, p. 19-37, illus., tables, 1970.

By examining density distribution of poles [hkl] over the reciprocal lattice sphere, given idealized girdle and point distributions of a reference direction $[hkl]_o$, a series

of 'anisotropy' coefficients has been derived which describes density of any [hkl] at any point on the reciprocal lattice sphere. Coefficients are used in calculation of diffraction intensities for an anisotropic mineral fabric whose $[hkl]_o$ pole figure can be described by a number of superimposed point and girdle maxima. Calculations are made by combining appropriate anisotropy coefficients with area-corrected pole density data obtained from contour values of $[hkl]_o$ distributions, and standard calculated intensities for the given material. Calculated and observed diffraction patterns for apatite in bovine tibia and calcite in Yule marble are in good agreement. — *from* Author's abstract

06333 **Davis, J. B.; Stanley, J. P.; Custard, H. C.** Evidence against oxidation of hydrogen sulfide by sulfate ions to produce elemental sulfur in salt domes: Am. Assoc. Petroleum Geologists Bull., v. 54, no. 12, p. 2444-2447, 1970.

Oxidation of hydrogen sulfide to elemental sulfur by sulfide ions has been proposed as the means of sulfur formation of salt dome sulfur deposits. Theory and experiment do not indicate that significant quantities of sulfur would result from such reactions. It appears that dissolved oxygen in waters is a more probable oxidizing agent. — SEF

05959 **Davis, Mary W.; Ehrlich, Robert.** Relationship between measures of sediment-size-frequency distributions and the nature of sediments: Geol. Soc. America Bull., v. 81, no. 12, p. 3537-3548, illus., 1970.

The efficacy of indices characterizing grain-size-frequency distributions was evaluated for response of size distribution measures to variations of a theoretical model of two normal subpopulations. Results indicate percentile measures are not faithful counterparts of formal central-moment measure, and that combinations of two or more nonpercentile based measures can limit greatly the number of possible distributions for sets of statistical values and in some cases define them completely. Evaluation of empirical data indicates that water- and wind-deposited sediment can be described effectively using relatively simple models. — *from* Authors' abstract

Dawe, G. L. *See* Rodda, Peter U. 06375

06242 **Dawes, Peter R.; Soper, N. J.** Geological investigations in northern Peary Land, *in* Report of activities, 1969: Grönlands Geol. Undersögelse Rap. 28, p. 9-15, illus., 1970.

Reconnaissance within the North Greenland Fold Belt was made by sledge over sea-ice and by ski and on foot in the Roosevelt Fjelde, collecting supplementary data north of Frederick E. Hyde Fjord and west to Lockwood Island for a geologic map at 1:250,000. Much of the folded zone, Cambrian to Silurian, is argillaceous and arenaceous strata with some fossiliferous calcareous units, in contrast with a calcareous foreland and younger northwestern volcanics; to the north is a complexly folded metamorphic succession. Some of Frankl's names (1955) are retained in central part, others discontinued in north, and modified in south. Basic intrusives are grouped as metamorphosed layers, ophitic or schistose sills and dikes, and unmetamorphosed dike swarms. Northern folds are overturned northward; the main structure trends E-W, changing strike in southwest to NW and even N-S; the only major thrust separates the volcanics and overlying low-grade metamorphics. — GDC

06343 **Dawes, Peter R.** Quaternary studies in northern Peary Land, *in* Report of activities, 1969: Grönlands Geol. Undersögelse Rap. 28, p. 15-16, 1970.

Pelecypods for radiocarbon dating were collected from Quaternary marine clay and silt, the highest level of which, in Nordpasset, was over 60 m. It is generally accepted that glacial till of northern Peary Land is locally derived in the northern part, while the southern heterogeneous assemblage contains crystalline granites and gneisses derived both locally and from a distance; the boundary between the two tills is the northern limit of the Greenland ice cap. Boulders and pebbles of a variety of crystalline rocks, collected from ground moraine on the north coast, clearly were not derived from the exposed bedrock of northern Peary Land, but from the same source as erratics in the southern till. A postulated central nucleus of gneiss and granite,

disputed in 1955, is now known through field work to be nonexistent. One provenance may have been a land mass across the Arctic Ocean. — GDC

Dawson, J. P. *See* Cremers, C. J. 06273

Decker, Robert W. *See* Unger, John D. 06462

06221 **Deep Sea Drilling Project.** (Scientific Staff). Deep Sea Drilling Project, Leg 12: Geotimes, v. 15, no. 9, p. 10-14, illus., table, 1970.

Thirteen holes were drilled from *Glomar Challenger* at 9 sites in four geographic regions in the North Atlantic: the Labrador Sea, Reykjanes Ridge, Rockall area, and Bay of Biscay. Two holes at the first site, on an isolated knoll northeast of Newfoundland, indicate onset of glaciation in mid-Pliocene. The knoll appears to be a continental fragment that foundered. Two holes at the second site, in the middle of the Labrador Sea, encountered basement basalt at about 660 m overlain by red baked clay below 115 m of Pliocene-Pleistocene sediments. At the third site, in 3,629 m of water just south of the axis of the sediment-buried Mid-Labrador Sea Ridge, the hole had to be abandoned at 927 m still in Miocene. Other sites drilled farther east show two unconformities in the lower Tertiary, gradual sinking of the Hatton-Rockall basin, and many turbidity deposits. — ESL

05919 **DeFord, Ronald K.; Haenggi, Walter T.** Stratigraphic nomenclature of Cretaceous rocks in northeastern Chihuahua [abs.], *in* The geologic framework of the Chihuahua tectonic belt — Symposium in honor of Ronald K. De Ford, Midland, Tex., 1970: Midland, Tex., West Texas Geol. Soc., p. 60, 1970.

deKimpe, C. *See* Colmet-Daage, F. 05900

06130 **deLaRüe, E. Aubert.** Les îles Saint-Pierre et Miquelon, une enclave subarctique méridionale [The Saint-Pierre and Miquelon islands, a southern subarctic enclave (with English abs.)], *in* Ecology of the subarctic regions (Écologie des régions subarctiques) — Helsinki, Symposium, Proc.: Paris, UNESCO, p. 289-293, discussion, 1970.

This small archipelago, off the southern coast of Newfoundland, probably constitutes one of the deepest incursions of the subarctic into temperate regions. Morphology of the Islands has been greatly influenced by the Labrador ice-cap, which entirely covered them in the Quaternary, leaving behind a thick layer of clayey moraines, the cause of the impermeability of the soil. Vegetation is of two types: a forest of subarctic conifers, now sparse and stunted, and sphagnum peat bogs, studded with pools, and encroaching on the forest. — *from* Author's abstract

Delaune, M. *See* Colmet-Daage, F. 05900

05955 **DeLeenheer, L.** Memorial of Prof. Alfred Schoep — June 6, 1881-June 1, 1966: Am. Mineralogist, v. 55, nos. 3-4, p. 597-602, portrait, 1970.

06154 **Denechaud, E. Barton.** Rare-earth activation analysis — Development and application to Stretishorn dike and Duluth Complex [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 12, pt. 1, p. 5396B, 1970.

06229 **Dengo, Gabriel; Bohnenberger, Otto; Bonis, Samuel.** Tectonics and volcanism along the Pacific marginal zone of Central America [with German, Spanish, and Russian summ.]: Geol. Rundschau, v. 59, no. 3, p. 1215-1232, illus., 1970.

The deep trench off the Pacific coast of Central America, a parallel seismic belt, and a similarly oriented chain of volcanic vents farther inland form a tectonic unit, here termed the Pacific marginal zone. Seismic focuses on the northeast edge of the trench define a fault zone dipping under the continent, suggesting movement of the oceanic plate under the continent. A chain of volcanoes and shallow earthquake focuses is alined along a graben which probably originated in Late Tertiary time. In Nicaragua and El Salvador the oldest cones are situated on the northeast boundary of

this graben. All the active volcanoes are on the southwest boundary. The distribution of vents, with N-S trends controlled by cross faulting, underscores the close tectonic control of volcanism. The main graben and associated faults are the result of tension at the crest of a geanticline, arched by compression as the oceanic plate moves against the continent. — DBV

05905 **Denison, Rodger.** Basement rock framework of parts of Texas, southern New Mexico and northern Mexico [summ.], *in* The geologic framework of the Chihuahua tectonic belt — Symposium in honor of Ronald K. De Ford, Midland, Tex., 1970: Midland, Tex., West Texas Geol. Soc., p. 4-6, 1970.

06206 **Desai, Jyotindra I.** Petrography of the Kaibab and Plympton formations (Permian), near Ferguson Mountain, Elko County, Nevada: Brigham Young Univ. Geology Studies, v. 17, pt. 2, p. 67-81, illus., 1970.

The northernmost complete surface section of the mid-Permian upper Loray, Kaibab, Plympton and Indian Canyon formations on northeastern Ferguson Mountain south of Wendover, Utah-Nevada, measures about 450 feet; 180 thin sections were prepared from samples of the measured section. The carbonate rocks are algal-micrite, bryalgal limestone, crystalline limestone, and diagenetically dolomitized limestones. Diagenetic dolomitization created highest permeability and porosity, formation of shrinkage cracks, and pin-point to vuggy porosity along which migration of hydrocarbons was effected; residual oil is present along channels and within pore spaces. Contiguous regions to the north and northeast have not been tested for oil and gas; if the shallow marine seaway in which these sediments accumulated was near a northern shoreline, then exploratory subsurface tests can be encouraged. — *from* Author's abstract

06176 **Desborough, George A.; Raymond, William H.; Soule, Courtney.** Placer gold of unique fineness in Douglas and Elbert Counties, Colorado, *in* Geological Survey research 1970, Chap. D: U.S. Geol. Survey Prof. Paper 700-D, p. D134-D139, illus., table, 1970.

Electron-microprobe studies show that placer gold from the Russellville placers, Douglas and Elbert Counties, Colo., contains less than 1 percent silver. Gold from the known lodes in Colorado contains at least 10 times this amount of silver. The Russellville placers are in recent alluvium, and their gold is derived from fossil concentrations in the Castle Rock Conglomerate. The lode source of the Russellville gold is unknown, but as shown by sedimentary structural features in the Castle Rock Conglomerate and by the presence of gold of similar purity in mountain gravels east of Woodland Park, the source area lies to the west or southwest. — Authors' abstract

Dickey, D. D. *See* Bucknam, R. C. 06077

Dickey, Parke A. *See* Cartmill, John C. 06332

06364 **Dickinson, William R.** Relations of andesites, granites, and derivative sandstones to arc-trench tectonics: Rev. Geophysics and Space Physics, v. 8, no. 4, p. 813-860, illus., tables, 1970.

It is suggested in this paper that andesitic volcanism and granitic plutonism are the main processes by which new continental crust emerges or reappears from the mantle. Linear wells of associated volcanic arcs, batholiths, and derivative graywacke and arkose belts are probably composed mainly of materials emergent by multistage processes from subcrustal regions and are not derived from adjacent continental masses. The concept of plate tectonics involving a large segment of the upper mantle as well as crust permits an hypothesis of inseparably linked crustal slabs and subjacent mantle blocks of roughly complementary composition and heat reproduction. This mobilist view offers more flexible petrologic interpretations. Circum-Pacific studies indicate that andesitic eruptive and granitic intrusive suites, which have shed voluminous detritus into coeval graywacke-arkose belts nearby, are analogs of tectonic settings in which the three related rock assemblages were formed. — VSN

05865 **Dobrin, Milton B.** Geophysics — Key to understanding of geologic processes: Am. Assoc. Petroleum Geologists Bull., v. 54, no. 11, p. 1984-1988, illus., 1970.

This SEG presidential adress is an overview of recent geophysical contributions to the understanding of global tectonics. The central role of geophysics is illustrated by discussion of the area around the Red Sea and Gulf of Aden, where geologic movements are actively underway. Concepts such as plate tectonics and ocean-floor spreading promote a major revolution in geologic concepts of origin and development of continents, ocean basins, continental margins, geosynclines, tectonic movements, and the many offshore and onshore provinces which are present or prospective sources of petroleum. More skillful coordination of geology and geophysics in petroleum exploration, plus application of new concepts, may lead to new discoveries of oil and gas and thereby offset the continuing decline in oil and gas reserves. — BHK

00029 **Dodd, J. Robert; Siemers, Charles T.** Effect of late Pleistocene karst topography on Holocene sedimentation and biota, lower Florida Keys: Geol. Soc. America Bull., v. 82, no. 1, p. 211-217, illus., 1971.

Bedrock topography on Bahia Honda and Big Pine Keys reveals a buried karst topography, developed during lowered sea level of the Pleistocene, that controls Holocene sediment thickness and biotic distribution. Sink holes are well developed in the Miami Limestone and the Key Largo Limestone, both of late Pleistocene age, and are usually filled with peat and carbonate sediment. The sink holes are evident by nearly circular vegetation patterns. — *from* Authors' abstract

Dodd, J. Robert. *See* Stanton, Robert J., Jr. 05806

06211 **Dodge, F. C. W.; Fabbi, B. P.; Ross, D. C.** Potassium and rubidium in granitic rocks of central California, *in* Geological Survey research 1970, Chap. D: U.S. Geol. Survey Prof. Paper 700-D, p. D108-D115, illus., tables, 1970.

Trends of K-Rb ratios of granitic rocks from masses near the San Andreas fault yield an average ratio near 230 with some random variation at all K contents; Sierra Nevada batholith ratios decrease at higher K contents. Differences may be related to differences in water pressure during crystallization or to late-stage introduction of K-feldspar into granitic rocks near the San Andreas fault. Both K and Rb contents decrease westward across the Sierra Nevada, but lack of systematic variation of the K-Rb ratio with distance from the continental margin is inconsistent with the model relating landward increase of K solely to increasing depths during magma generation. Recent experiments by Green and Ringwood lead to expectation of a landward increase in K-Rb ratio; crystallization temperatures near 700°C are suggested by K and Rb partition coefficients of biotite and K-feldspar pairs. — *from* Authors' abstract

00019 **Doell, Richard R.; Cox, Allan.** Pacific geomagnetic secular variation: Science, v. 171, no. 3968, p. 248-254, illus., table, 1971.

Several different types of records of long-period geomagnetic secular variation all indicate that during the last 0.7 m.y. the nondipole component of the Earth's field was lower in the Pacific than elsewhere, as it is today. This in turn indicates some type of inhomogeneity in the lower mantle, coupled to the Earth's core in such a way as to suppress the generation of the nondipole field beneath the central Pacific. At present it is uncertain whether undulations in the core-mantle interface or lateral variations in the composition and physical state of the lower mantle are ultimately responsible for the pattern of secular variation as seen at the Earth's surface. — DBV

Doell, Richard R. *See* Dalrymple, G. Brent. 06274

06275 **Doell, Richard R.; Grommé, C. Sherman.** Magnetic studies of Apollo 11 lunar samples, *in* Apollo 11 Lunar Sci. Conf., Houston, Tex., 1970, Proc. — V. 3, Physical properties: New York, and Oxford, England, Pergamon Press (Geochim. et Cosmochim. Acta Supp. 1), p. 2097-2102, illus., table, 1970.

The remanent magnetism of a lunar type C breccia sample included a large viscous component with a time constant of several hours, and a high coercivity remanence, possibly acquired by impact processes on the lunar surface. Ilmenite(,) and metallic iron in breccia, and ferrous and metallic iron in glass beads separated from lunar fines (type D) were identified by high field and low temperature experiments. The iron appears to occur in a wide range of grain sizes, including the single domain and multidomain states. — Authors' abstract

00008 **Dolan, Robert.** Coastal landforms, crescentic and rhythmic: Geol. Soc. America Bull., v. 82, no. 1, p. 177-180, illus., 1971.

Crescentic shoreline landforms are common along many sandy coasts. Some of these migrating rhythmic forms reflect interacting processes and systematic bar-and-trough configurations within the surf zone. The rate of migration along the coast is greater during the stormy winter season. These forms must be better understood for more efficient engineering and experimental design. — Author's abstract

Dollfus, A. *See* Geake, J. E. 06277

Drew, Isabella M. *See* Kerr, Paul F. 05794

00027 **Drewes, Harald.** Geologic map of the Sahuarita quadrangle, southeast of Tucson, Pima County, Arizona: U.S. Geol. Survey Misc. Geol. Inv. Map I-613, scale 1:48,000, sections, 1971.

Dugdale, R. E. *See* Andrews, J. T. 05970

Dunn, David E. *See* Roper, Paul J. 06433

06145 **Dupuy, Leon W.** Mineral resources, App. K *in* Potomac River basin report, V. 4: U.S. Cong., 91st, 2d sess., House Doc. 91-343, 15 p., paged separately, 1970.

As requested, 21 proposed reservoir sites were studied, office records consulted, and determinations made as to whether the reservoirs would inundate any active mining properties. Eight of the projects appeared to involve mineral resources, and for each a reconnaissance examination was undertaken. For most of the locations, no damage or impairment to mineral production would be involved; where such possibility exists, it is noted in specific coverage for each site studied. There has been sporadic petroleum exploration, mainly for gas, but no commercial production, and present evidence indicates it is unlikely that future reserves will be found. — GDC

Durrani, Saeed A. *See* Christodoulides, Costas. 06443

05977 **Easterbrook, Don J.; Rahm, David A.** Landforms of Washington — The geologic environment: Bellingham, Wash., Western Washington State College, Dept. Geology, 156 p., illus., tables, 1970.

The great variety of geomorphic processes that have operated in the State of Washington provides a nearly complete review of mechanisms of landscape development. This text describes the form and evolution of the features of the Cascade Mountains, Puget Lowland, Coast Ranges, Columbia Basin, and Northern Rocky Mountains. — VSN

05997 **Eastwood, Raymond Lester.** A geochemical-petrological study of Mid-Tertiary volcanism in parts of Pima and Pinal Counties, Arizona [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 12, pt. 1, p. 5554B, 1970.

05998 **Ebtehadj, Khosrow.** Palynology of the subsurface Frio Formation in Liberty and Chambers Counties, Texas [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 12, pt. 1, p. 5554B, 1970.

06258 **Economou, Thanasis E.; Turkevich, Anthony L.; Sowinski, Kenneth P.; Patterson, James H.; Franzgrote, Ernest J.** The alpha-scattering technique of chemical analysis: Jour. Geophys. Research, v. 75, no. 32, p. 6514-6523, illus., tables, 1970.

The α-scattering technique of chemical analysis as used on the Surveyor lunar missions is described. Improved α sources and methods of data analyses lead to appreciably better results than those achieved previously by this technique. The accuracy of the α-scattering method has been tested through the analysis of eleven rocks of known composition using a space Surveyor instrument. These results have provided the basis for estimation of the errors of the lunar surface analyses on Surveyors 5, 6, and 7. Some nonstandard geometrical relationships of sample to instrument, such as were encountered on the Surveyor missions, have been studied and their effects estimated. As a by-product of this work, chemical analyses of five rocks of unknown composition were obtained. — Authors' abstract

Edgar, A. D. *See* Sood, M. K. 06109

Edgington, J. A. *See* Blair, I. M. 06271

Edmunds, Frederick R. *See* Bishop, Donald. 06064

Ehrlich, Robert. *See* Davis, Mary W. 05959

05951 **El-Baz, Farouk; Gheith, Mohamed A.** Memorial of Riad Abdel-Megid Higazy — September 13, 1919-March 7, 1967: Am. Mineralogist, v. 55, nos. 3-4, p. 569-573, portrait, 1970.

Elleman, Daniel D. *See* Manatt, Stanley L. 06290

Elliott, G. K. *See* Sheridan, R. E. 05792

06451 **Ellis, J. G.; Stonehouse, H. B.** Pedology, *in* Physical environment of Saskatoon, Canada: Natl. Research Council Canada Pub. 11378, p. 19-20, illus., 1970.

Soils in the Saskatoon area are developed on glacial till; glacio-lacustrine, glacio-fluvial, and recent alluvium; and aeolian deposits. This variety of parent materials illustrates the complexity resulting from glaciation and subsequent deposition from melting ice and melt waters. Recognition of parent materials is a part of the criteria used for establishing Soil Associations. Soil profiles of a given association occur in adjacent local areas, developed in a particular kind of geologic deposit described and defined as a specific soil parent-material, apparently under conditions of external climate associated with a recognized soil zone identified by surface color. Light brown is associated with thin grass cover of the drier southwest area of Saskatchewan; darker brown to black colors of the Saskatoon area are associated with thicker grasses in a more humid region. A map of soil associations is included. — GDC

06241 **Elltsgaard-Rasmussen, K.** General review of the Survey's activities in 1969, *in* Report of activities, 1969: Grönlands Geol. Undersögelse Rap. 28, p. 5-9, illus., 1970.

Reported here are progress of the Geological Survey of Greenland in geologic mapping, economic-geologic investigations, and publication; assistance to private exploring companies, and studies of various potential mineral resources, including ores in layered hornblende peridotite intrusions (late Ketilidian); expeditions into new territory in the Scoresby Sund area and West Greenland, with use of geoelectric methods for measuring depth to permafrost table, and supplemental geophysical surveys and aerial photography. Close collaboration has been maintained with many other Danish and foreign institutes with progress in providing factual basis for correlation of geologic units on each side of Davis Strait. The permanent staff of 16 geologists and 1 chemist is supplemented in field season by 26 geologists from other institutes and 22 senior students; total number of participants in summer excursions was 117 plus 30 Greenlanders. — GDC

06249 **Emeleus, C. H.; Stephenson, D.** Field work between Tunugdliarfik and Tasiussaq, *in* Report of activities, 1969: Grönlands Geol. Undersögelse Rap. 28, p. 30-32, illus., table, 1970.

Major sinistral transcurrent faults cut Igaliko nepheline syenites and associated dike swarms in this area. Lateral movements of four nearly E-W faults, south of

Qagssiarssuk, were determined across a distinctive swarm of big feldspar dikes, together with several red- or orange-brown porphyry trachytes 10-15 m wide. Details measured on dike traverses are tabulated. Briefly: Fault 1, striking WNW near Qagssiarssuk, offset the dikes about 400 m, with downthrow to the south 100 m or more; Fault 2, a broad, gently curving crushed zone, offset them 5 km, perhaps in parallel fractures, downthrown to north; Fault 3, striking WNW from Nugarssuk and downthrown to south, offset the group about 700 m, one big feldspar dike 800 m, and trachytes 600 m; Fault 4, striking close to E-W between fjords, with downthrow to north and apparently insignificant lateral movement, is probably a younger normal fault. — GDC

Engstrom, J. C. *See* Fraunfelter, G. H. 05862

Ensminger, H. Robert. *See* Walker, Jack R. 05873

Epstein, S. *See* Land, Lynton S. 06235

05934 **Erd, Richard C.; McAllister, James F.; Vlisidis, Angelina C.** Wardsmithite, $5CaOMgO12B_2O_330H_2O$, a new borate mineral from the Death Valley region, California: Am. Mineralogist, v. 55, nos. 3-4, p. 349-357, illus., tables, 1970.

Wardsmithite, $5CaOMgO12B_2O_330H_2O$, is a new borate found at two localities in the Death Valley region, Inyo County, California, on weathered veins of colemanite or priceite in the Furnace Creek Formation (Pliocene). It occurs as nodules and coatings in gowerite, ulexite, and colemanite. [Physical, chemical, and crystallographic data are given.] — *from* Authors' abstract

05894 **Ernst, W. G.** Pasipedeleniye elementov v tektonicheskikh vklyucheniyakh golubykh slantsev iz serpentinitov v Kaliforniyskikh Beregovykh Khrebtakh i diskussiya o tektonike golubykh slantsev [Element partitioning in blueschist tectonic inclusions from serpentinites in California Coast Ranges, and a discussion of blueschist tectonics (with English abs.)], *in* Problemy petrologii i geneticheskoy mineralogii, V. 2: Moscow, Akad. Nauk SSSR Sibir. Otdeleniye (Izdatel'stvo "Nauka"), p. 5-23, illus., tables, 1970.

A tectonic model is presented relating localization of blueschist facies metamorphism to a rapidly subsiding and filling ensimatic trench marginal to the continent. The tectogene is maintained because of sea-floor spreading, resulting from convecting suboceanic mantle. Underthrusting of continental by oceanic crust is a consequence and would result in tectonic thickening and deformation of the eugeosynclinal prism, and in depressed isotherms and elevated pressures characteristic of blueschist metamorphism. The zone of decoupling between mantle and oceanic crust would provide access for fluids and facilitate rise of hydrated mantle material through the crust; such ultramafics should contain tectonic inclusions of both basement and ensimatic trench rocks. Element distribution in coexisting minerals from five glaucophane schist inclusions from serpentinites suggests recrystallization under differing conditions. — *from* Author's English abstract

06382 **Erwin, John W.** Gravity map of the Yerington, Como, Wabuska, and Wellington quadrangles, Nevada: Nevada Bur. Mines Map 39, scale 1:125,000, text, 1970.

Rocks in the Yerington area range from Triassic to Quaternary; present topography is the result of late Tertiary and Quaternary faulting and erosion. Four prominent gravity anomalies are shown on the map: (1) northern and southern Smith Valley lows; (2) central and south Mason Valley lows; (3) gravity high in T. 12 S., R. 26 E. of Mason Valley; and (4) two lows in northern Mason Valley. Embayments and areas of low gravity relief indicate pediments of areas of thin Tertiary cover; three other lows are associated with Tertiary volcanics or sediments. The determination of a regional gravity trend is difficult because of local variation in rock densities, particularly the Mesozoic metamorphics. Some rather high bedrock gravity values are indicated in the northeastern sector. — MCM

Eschman, Donald F. *See* Wagner, W. Philip. 05975

06016 **Esmail, Omar Jubran.** Ultrasonic reflection and transmission by submerged composite plates [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 12, pt. 1, p. 5564B, 1970.

Ettinger, Kamil V. *See* Christodoulides, Costas. 06443

Fabbi, B. P. *See* Dodge, F. C. W. 06211

Fairbairn, H. W. *See* Bottino, M. L. 06128

Fairbairn, Harold W. *See* Spooner, Charles M. 05964

05935 **Fang, J. H.; Robinson, P. D.** Crystal structures and mineral chemistry of double-salt hydrates — [Pt.] 2, The crystal structure of loeweite: Am. Mineralogist, v. 55, nos. 3-4, p. 378-386, illus., tables, 1970.

The crystal structure of loeweite, $6Na_2SO_4 7MgSO_4 15H_2O$, has been solved by reiterative application of Sayre's equation yielding a final R factor of 6.2 percent. The structure is unusual in that one of the three independent sulphate groups is disordered, giving rise to local noncentrosymmetry. The structure can be described as corner-sharing zig-zag chains of Mg octahedra and S tetrahedra, emanating in six directions from the corners of the Mg octahedron located at the center of the unit cell. The two non-equivalent Na atoms are in 7-fold coordination with the Na-O distances ranging from 2.31 to 2.87 A. The Mg-O distances vary within a small range of 2.01 to 1.12 A. The S-O distances in the two independent SO_4 groups average 1.47 and 1.48 A respectively, while the mean distance in the disordered SO_4 group is 1.60 A. — Authors' abstract

Faraham, Paul R. *See* Mooney, Harold M. 05876

Fawcett, J. J. *See* Grieve, R. A. F. 05945

Feltz, H. R. *See* Wark, J. W. 06147

Ferguson, George E. *See* Guy, Harold P. 06390

06150 **Ferguson, John.** The differentiation of agpaitic magmas — The Ilimaussaq Intrusion, South Greenland, *in* Alkaline rocks, the Monteregian Hills — Symposium, Montreal, 1969, Proc.: Canadian Mineralogist, v. 10, pt. 3, p. 335-349, illus., tables, 1970.

In the nepheline- and sodalite- rich rocks of the Ilimaussaq intrusion, alkalies are in excess of alumina, and total Fe, Zr, H_2O, Cl and F is high with a corresponding paucity of Ca and Mg. Furthermore, Na is considerably in excess of K. The major chemistry has resulted in the development of the agpaitic suite of minerals. The fractionation trend displayed by the K:Rb ratio shows a remarkably strong correlation with the chronology determined from the field evidence. Other ratios used include the agpaitic index, Na:K, Sr:Ca, Ba:Rb, Ba:Sr, Ti:Zr, Ti:Nb and Zr:Nb. In general these ratios conform to established behaviour patterns during fractionation; an exception is the Zr:Nb ratio which increases with fractionation. — Author's abstract

Fielder, G. *See* Bastin, J. A. 06269

05939 **Fielding, P. E.** The distribution of uranium, rare earths, and color centers in a crystal of natural zircon: Am. Mineralogist, v. 55, nos. 3-4, p. 428-440, illus., tables, 1970.

The uranium content and its distribution in a zoned crystal of zircon (hyacinth) is determined by the Lexan print technique. Flourescence photography and spectroscopy establishes the distribution of praseodymium. The relationship between these impurities and the color centers responsible for the characteristic red coloration is examined. It is concluded that the centers are Nb^{4+} ions produced by the radiation induced reduction of Nb^{5+} ions which occupy certain Zr^{4+} sites. The presence of a defect with a characteristic absorption band at 3400 cm^{-1} is required before the reduction can proceed in a natural crystal. — Author's abstract

05904 **Fischbuch, N. R.** Devonian reef-building stromatoporoids from western Canada: Jour. Paleontology, v. 44, no. 6, p. 1071-1084, illus., 1970.

The organic framework of the Devonian Swan Hills reef complexes consists mainly of stromatoporoids; in the reef and fore-reef facies there is a close physical relationship between ramose and tabular or subspherical forms, which is reflected in their microstructures: *Trupetostroma warreni* Parks has a dendroid counterpart, *T. ernodes* n.sp.; *T. cervimontanum* Stearn is microstructurally similar to the dendroid *T. keratodendroides* n.sp. *Stachyodes costulata* Lecompte is transferred to *Syringostroma* to ally it more closely with a microstructurally similar but tabular form, *Syringostroma? confertum* (Stearn). Other dendroid forms, *T. mclearni* (Stearn), *Stachyodes spongiosa* Stearn, *S. verticillata* (McCoy), *S. thomasclarki* Stearn, and subspherical forms *Trupetostroma* cf. *T. tenue* Stearn, and *T. pseudopingue* Stearn are also recognized. ⌐ *from* Author's abstract

00035 **Fisher, George W.** Kyanite-, staurolite-, and garnet-bearing schists in the Setters Formation, Maryland Piedmont: Geol. Soc. America Bull., v. 82, no. 1, p. 229-232, illus., table, 1971.

Reconnaissance studies of the Setters Formation, the basal unit of the Glenarm Series, confirm early reports that kyanite, staurolite and abundant garnets occur in the schists at the top of the formation, and refute recent statements to the contrary. Kyanite, staurolite, and garnet are most abundant in the Setters schist north of Texas, Maryland. South of that point, the schist contains little or no kyanite or staurolite, and only rare garnet, possibly reflecting a change in sedimentary facies. — Author's abstract

05968 **Fisher, Irving S.** Selective weathering of dolomite bodies from a limestone host: Geol. Soc. America Bull., v. 81, no. 12, p. 3757-3758, illus., 1970.

A weathering pattern in which saccharoidal dolomite is removed from a biopelmicritic limestone may be observed in some Lower Ordovician rocks of central Kentucky. Experiments indicate that the pattern initiates from combined solution and frost wedging. Once established, the selective removal of dolomite is probably spatially concentrated by the preferential collection of water on the rougher dolomite surfaces. — Author's abstract

Fisher, R. M. *See* Nagata, T. 06352

06466 **Fix, James E.; Sherwin, John R.** A high-sensitivity strain/inertial seismograph installation: Seismol. Soc. America Bull., v. 60, no. 6, p. 1803-1822, illus., table, 1970.

A seismograph complex consisting of short-period (SP), long-period (LP), and extended long-period (XLP) inertial and strain seismographs has been installed. Routine magnifications on the 20-trace, 16-mm film recorders for all three components are: SP inertial, 500 K; LP inertial, 100 K. Noise levels permit equivalent magnifications on strain seismographs. The complex provides seismic wave discrimination by directional response, which is independent of period, and by detection of differences in phase velocities between P, S, Love, or Rayleigh arrivals. Strain seismographs use 40-m-long rods and moving coil transducers with generator constants of 32,000 v/m sec. They sense waves of 5×10^{-13} strain at 30 sec and reject the 2×10^{-8} earth-tide strain. A low-noise preamplifier drives a filter assembly which provides SP, LP, and XLP strain outputs. The complex is installed in an abandoned mine 50 km southeast of Phoenix, Ariz. — *from* Authors' abstract

06026 **Flawn, Peter T.; Muehlberger, William R.** The Precambrian of the United States of America — South-central United States, *in* The geologic systems — The Precambrian, V. 4 (Kalervo Rankama, editor): New York and London, Interscience-John Wiley and Sons, p. 73-143, illus., tables, 1970.

Precambrian rocks of south-central U.S. are exposed in the Ozark region of Missouri, the Arbuckle and Wichita Mts. of Oklahoma, and the Llano and Van Horn areas of Texas. Between outcrops buried rocks have been reached by many deep wells. Available data indicate: relics of pre-2000-m.y. rocks in northeastern Kansas; 1600-

1800-m.y. basement may be in northeastern Kansas and adjacent Missouri; a major geosynclinal cycle 1350-1450 m.y. ago; rocks in northeastern Oklahoma lie between a slightly older sequence in Missouri, 1200-1300 m.y., and a younger sequence in the Texas Panhandle, 1100-1200 m.y.; a geosynclinal facies along the Texas-Oklahoma boundary; and shelf facies in Kansas, western Missouri, Trans-Pecos Texas, Texas Panhandle, and eastern New Mexico. A final igneous event occurred in Cambrian time. — VSN

06372 **Flint, Gordon W.** The Trona Pinnacles: Our Public Lands, v. 20, no. 4, p. 8-9, illus., 1970.

The playa called Searles Lake, Calif., contains more than 500 trona pinnacles 30-140 feet high, and 10,000 to 100,000 years old. During the Pleistocene this lake was part of a chain of lakes forming a complete drainage system. The water carried salts which were left behind when it evaporated. The trona castles were formed by hundreds of springs in an arm of the lake. It is believed that they originated either by inorganic precipitation or by the action of blue-green algae. — ESL

Folsom, T. R. *See* Spencer, Derek W. 06407

06220 **Foscolos, A. E.; Barefoot, R. R.** A buffering and standard addition technique as an aid in the comprehensive analysis of silicates by atomic absorption spectroscopy: Canada Geol. Survey Paper 70-16, 15 p., illus., tables, 1970.

Silicate standards were fused with boric acid-lithium carbonate flux and then dissolved in dilute nitric acid. The chemical and/or ionization interference of calcium, magnesium and potassium which occur in atomic absorption spectroscopy are overcome by the combined use of buffering and standard addition (spiking). The method provides an exact measure of the reduced interferences and minimizes the use of expensive lanthanum compounds. The results compare favorably with those obtained on the same samples by analysts using other techniques. — Authors' abstract

Frankel, L. *See* Crowl, G. H. 05820

Franz, Ulrich. *See* Berggren, W. A. 06160

Franzgrote, Ernest J. *See* Economou, Thanasis E. 06258

05862 **Fraunfelter, G. H.; Engstrom, J. C.** Development of the rugose coral *Microcyclus discus* Meek and Worthen from the Devonian of Illinois and Missouri: Jour. Paleontology, v. 44, no. 6, p. 1085-1091, illus., 1970.

More than 750 specimens of *Microcyclus discus* Meek and Worthen were studied from the Middle Devonian St. Laurent Limestone of southwestern Illinois and southeastern Missouri. The shape of the corallum is highly variable. Minor septa are added by intercalation; apparent bifurcation is probably due to weathering. Coralla ranging in diameter from 3 mm to 11 mm may represent the neanic growth stage, those from 11 mm to 14 mm the ephebic stage, and those larger than 14 mm the gerontic stage. Rate of septal addition shows marked decrease beyond the 11 mm diameter. *Microcyclus macilentus* Stauffer, *M. planoconvexus* Stauffer and *M. ventricosus* Stauffer probably represent the gerontic stage, and *M. microdiscus* Stauffer the late neanic stage of *M. discus*. — *from* Authors' abstract

06025 **Frazier, Gerald Alvin.** Vibrational characteristics of three-dimensional solids, with applications to earth dams [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 12, pt. 1, p. 5532B, 1970.

05812 **Freeze, R. A.; Banner, J. A.** An instrumented experimental site for the investigation of soil moisture, frost, and groundwater discharge: Canada Dept. Energy, Mines and Resources Inland Waters Br. Tech. Bull. 21, 29 p., illus., table, 1970.

An instrumented experimental site established at Calgary provides integrated measurements of the subsurface moisture regime in both saturated and unsaturated

zones. A soil-moisture measuring system utilizing both resistance cells and a neutron probe has advantages over single-instrument systems, particularly in determination of frost and winter soil-moisture conditions. The site, in a regional ground-water recharge area, has a vertical, saturated, hydraulic gradient of 0.45, which remains remarkably constant through the year. Two mechanisms lead to water-table rises: a direct vertical infiltration to the water table through the unsaturated zone, and a depression-focused recharge involving horizontal infiltration from a nearby slough. — *from* Authors' abstract

Frey, F. A. *See* Buma, Grant. 06079

Friedman, Gerald M. *See* Schoettle, Manfred. 00034

06215 **Frisch, Thomas.** Chemical variations among the amphiboles of Shefford Mountain, a Monteregian intrusion in southern Quebec, *in* Alkaline rocks, the Monteregian Hills — Symposium, Montreal, 1969, Proc.: Canadian Mineralogist, v. 10, pt. 3, p. 553-570, illus., table, 1970.

Amphiboles in rocks from the differentiation sequence of the Monteregian complex were analyzed by electron microprobe. With decreasing Mg/Mg + Fe + Mn, which grossly correlates with decreasing basicity of host rocks, amphiboles become poorer in Ti, Al, and Ca, and richer in Mn; enrichment in Na appears in syenitic amphiboles. Fluctuations, notable among brown amphiboles of early differentiation, are probably attributable to variations in conditions of crystallization, or, in those replacing pyroxene, to chemical control by parent mineral composition. Characteristic amphibole of gabbros and diorites is kaersutite, which, in monzodiorites and monzonites, becomes increasingly zoned to green magnesian hastingsite. Feldspathoidal syenites contain sodic magnesian hastingsite, and in quartz syenite it is arfvedsonitic. The kaersutite — hastingsite transformation represents a continuous reaction; the transitional nature of the hastingsite to arfvedsonitic amphibole change suggests solid solution between them. — *from* Author's abstract

Frye, John C. *See* Willman, H. B. 05818

06276 **Fryxell, Roald; Anderson, Daniel; Carrier, David; Greenwood, William; Heiken, Grant.** Apollo 11 drive-tube core samples, an initial physical analysis of lunar surface sediment, *in* Apollo 11 Lunar Sci. Conf., Houston, Tex., 1970, Proc. — V. 3, Physical properties: New York, and Oxford, England, Pergamon Press (Geochim. et Cosmochim. Acta Supp. 1), p. 2121-2126, illus., tables, reprinted 1970.

Two drive-tube core samples were obtained at Tranquillity Base. Fines include much glass, are unweathered, medium gray, loose, nonstructured, very weakly coherent and demonstrate both accumulation and mixing in a waterless vacuum environment. In contrast to chemical weathering characteristic on the earth, lunar alteration processes are primarily mechanical. We infer that environmental processes of the lunar surface may be expressed as follows: R (regolith) $= f(cl, p,r,t,b,a \ldots)$, in which climate ($cl$) is constant and the time (t)-dependent processes of bombardment (b) and accumulation (a) assume significance unparalleled on the Earth because of their effects on parent material (p) and relief (r). — Authors' abstract

Fullagar, P. D. *See* Bottino, M. L. 06128

Funkhouser, J. G. *See* Schaeffer, O. A. 06437

06330 **Furer, Lloyd C.** Petrology and stratigraphy of nonmarine Upper Jurassic-Lower Cretaceous rocks of western Wyoming and southeastern Idaho: Am. Assoc. Petroleum Geologists Bull., v. 54, no. 12, p. 2282-2302, illus., 1970.

Montmorillonite in the Morrison, "upper" Ephraim, and Cloverly Formations is an alteration product of volcanic ash blown from centers in western California and Oregon during Late Jurassic, and from sources farther north during Early Cretaceous. Petrologic similarities, especially of feldspar and chert, between the Morrison Formation in central Wyoming and "lower" Ephraim Formation in the

Wyoming-Idaho thrust belt suggest common sources and time equivalence. Abrupt coarsening and influx of phosphorite and spicular chert detritus at the base of the Cretaceous Cloverly Formation and basal conglomerate of the "upper" Ephraim Formation suggest a change in provenance accompanied tectonic disturbances. Limestone clasts in conglomerates came from Pennsylvanian and Permian rocks of Idaho and northern Nevada. This and concurrent textural coarsening suggest that basal Cloverly is largely time equivalent to the lowest widespread conglomerate in the Ephraim. — *from* Author's abstract

Fusil, G. *See* Colmet-Daage, F. 05900

05858 **Gable, D. J.; Sims, P. K.; Weiblen, P. W.** Thermal metamorphism of cordierite-garnet-biotite gneiss, Front Range, Colorado: Jour. Geology, v. 78, no. 6, p. 661-685, illus., tables, 1970.

Precambrian gneiss remetamorphosed to hornblende-hornfels facies in thermal aureoles of Tertiary granitic stocks in the Front Range, Colorado, shows isochemical breakdown of garnet and biotite of regional metamorphism to cordierite, biotite, magnetite, and quartz. Also quartz, sillimanite, and biotite reacted to produce cordierite, biotite, K-feldspar, muscovite, magnetite, and ilmenite. If these two reactions were simultaneous, charge balance was maintained, and hydrogen was produced. The breakdown of garnet and biotite in the thermal aureoles occurred at lower temperatures, but higher oxygen fugacities than in the regional metamorphism. — *from* Authors' abstract

05816 **Gafarov, R. A.** Glubinnaya tektonika i tipy magnitnykh poley drevnikh platform severnykh materikov Zemli [Deep tectonics and types of magnetic fields in the old platforms of the northern continents of the Earth]: Geotektonika 1970, no. 4, p. 33-42, illus., 1970.

This paper compares basement structures of the East European, Siberian, and North American platforms on the basis of a systematization and tectonic interpretation of different types of magnetic anomalies found over them, together with a wide assortment of other geologic and geophysical data. It was possible to relate main types of magnetic anomalies to the age and structure of the main folded complexes in the basement. The ancient continental nuclei in all three platform regions are characterized by a complex mosaic magnetic field, and the geosynclinal folded zones separating and surrounding them by very extensive belts of magnetic highs and lows. Analysis of schemes of internal structure of the basement in all three platforms, worked out with aid of geophysical and drilling data, leads to conclusions concerning the tectonic evolution and structural relationships of the major folded complexes. — DBV

Galabova, Iliana M. *See* Kerr, I. S. 05940

06213 **Gandhi, S. S.** Petrology of the Monteregian intrusions of Mount Yamaska, Quebec, *in* Alkaline rocks, the Monteregian Hills — Symposium, Montreal, 1969, Proc.: Canadian Mineralogist, v. 10, pt. 3, p. 452-484, illus., tables, 1970.

Two major intrusions of the igneous complex of Mount Yamaska are shallow-seated, vertical pipe-like in form, and subsiliceous calcic basaltic in composition. They are strongly differentiated, with ultramafic rocks at their cores and progressively more felsic rocks towards their boundaries. The older intrusion, 2.8 square miles in area, has differentiates ranging from ultramafic "older yamaskite" through gabbro to silica-saturated akerite. On its southwestern margin is the younger intrusion, which is 0.3 square mile in area and has differentiates ranging from ultramafic "younger yamaskite" to nepheline-bearing essexite. Differentiation trends of the intrusions are discussed in light of the known phase relations. — Author's abstract

Gard, J. A. *See* Kerr, I. S. 05940

Garlick, G. F. J. *See* Geake, J. E. 06277

Garner, L. E. *See* Rodda, Peter U. 06375

Gautheyrou J. *See* Colmet-Daage, F. 05900

Gautheyrou, M. *See* Colmet-Daage, F. 05900

Gawarecki, Stephen J. *See* Braddock, William A. 06415

Gaymard, R. *See* Poupon, A. 05903

06277 **Geake, J. E.; Dollfus, A.; Garlick, G. F. J.; Lamb, W.; Walker, G.; Steigmann, G. A.; Titulaer, C.** Luminescence, electron paramagnetic resonance and optical properties of lunar material from Apollo 11, *in* Apollo 11 Lunar Sci. Conf., Houston, Tex., 1970, Proc. — V. 3, Physical properties: New York, and Oxford, England, Pergamon Press (Geochim. et Cosmochim. Acta Supp. 1), p. 2127-2147, illus., 1970.

Samples of lunar fines 10084 luminesce weakly throughout the visible region when excited by 60 keV protons. Proton damage, recovery, and heating effects were investigated. Chips of breccia 10023 and 10059 luminesce from white inclusions under ultraviolet and proton excitation, while chips of rock 10058 show general luminescence; the main luminescent component in each case probably is plagioclase. One sample of fines showed weak X-ray excited thermoluminescence. Diffuse reflection spectrums for lunar fines are shown. The electron paramagnetic resonance spectrum shows the same broad dipole resonance (probably due to Fe^{3+}), for fines and fragments of some chips, but no response from others. Fines heated above 700°C show evidence of growth of magnetic ordering. Rock chips 10057-54 and 10058-37 show characteristics unlike any part of the lunar surface. The surfaces responsible are shown in scanning electron microscope photographs. — DBV

06409 **Gedney, Larry.** Tectonic stresses in southern Alaska in relationship to regional seismicity and the new global tectonics: Seismol. Soc. America Bull., v. 60, no. 6, p. 1789-1802, illus., table, 1970.

Fault plane solutions and a strain release map imply that southern Alaska performs in the role of a sink area unlike that of more classic trench-arc combinations. A broad, apparently interrelated zone of seismic activity extends from the Aleutian Trench to the base of the Alaska Range. While hypocentral distribution and relative seismicity imply that the entire area is performing as a sink for the North Pacific plate, fault plane solutions at the base of the Alaska Range are inconsistent with this premise. It is suggested that Cook Inlet and the lowlands north of Anchorage may represent an ancient trench. — Author's abstract

Gedney, Larry D. *See* Bufe, Charles G. 06078

Gheith, Mohamed A. *See* El-Baz, Farouk. 05951

Gibbs, G. V. *See* Brown, G. E. 06074

06304 **Gleeson, C. F.** Heavy mineral studies in the Klondike area, Yukon Territory [with French abs.]: Canada Geol. Survey Bull. 173, 63 p., illus., tables, 1970.

The Klondike area is underlain by various schists of the Nasina and Klondike Series. Foliated granite and ultramafic rocks cut both series as does a stock of biotite granite and Tertiary rhyolite porphyry bodies. Eocene sediments and tuffs are present, and andesite, diabase, and ultramafic dikes are common. Four types of lode gold deposits have been recognized: with quartz-barite veins; with quartz veins in chlorite schist; with quartz stringers in shear zones; and in Tertiary conglomerates (ancient placers). No new placers have been found, but large deposits of unworked high-level and valley gravels remain to be evaluated. Forty-eight heavy minerals have been found and described from the gravels of the area, but only gold is present in mineable quantities. Geochemical prospecting followed by panning for gold might be helpful in outlining lode gold-bearing structures. — *from* Author's abstract

Goddard, E. N. *See* Shoemaker, E. M. 06294

05988 **Godfrey, J. D.** Geology of the Marguerite River district, Alberta: Edmonton, Alberta, Research Council Alberta, scale 1:63,360, 1970.

06278 **Gold, T.; Campbell, M. J.; O'Leary, B. T.** Optical and high-frequency electrical properties of the lunar sample, *in* Apollo 11 Lunar Sci. Conf., Houston, Tex., 1970, Proc. — V. 3, Physical properties: New York, and Oxford, England, Pergamon Press (Geochim. et Cosmochim. Acta Supp. 1), p. 2149-2154, illus., 1970.

Reflectivity and polarization laws for the powder sample and its spectrum are close to the mean for the lunar maria. Solid samples show a marked absorption feature at 0.92 μm. The low albedo appears to be due to a surface coating on dust grains rather than to volume absorption. The high-frequency electrical properties resemble those of a fine powder made from typical dense terrestrial rocks and are consistent with previous estimates from ground-based radar observations. The differential mass spectrum is almost constant from 100-μm particles down to 0.1μm particles; most particles are smaller than 0.3 μm. Their shapes disclose a variety of processes of generation. — Authors' abstract

Golden, Julia. *See* Nitecki, Matthew H. 05819

05965 **Goldich, S. S.; Hedge, C. E.; Stern, T. W.** Age of the Morton and Montevideo gneisses and related rocks, southwestern Minnesota: Geol. Soc. America Bull., v. 81, no. 12, p. 3671-3695, illus., tables, 1970.

Granitic gneisses in the vicinities of Morton and Montevideo in the Minnesota River Valley are dated at 3550 m.y. ago and are the oldest rocks so far found in North America. The gneisses were altered in varying degree by younger events of which two have been dated at 2650 m.y. and 1850 m.y. The event which occurred 2650 m.y. ago was high-grade metamorphism accompanied by the intrusion of a large volume of granitic magma. The 1850-m.y.-ago event was a low-grade metamorphism that reset the K-Ar and Rb-Sr ages of biotite in the rocks between Granite Falls and Ortonville. Small plutons were also emplaced at this time. The Morton Gneiss was formed by synkinematic intrusions of trondhjemitic and granitic magmas, and the structure dates back to the time of the intrusions, 3550 m.y. ago. — *from* Authors' abstract

Goodell, H. G. *See* Huang, Ter-Chien. 05793

Goodman, A. *See* Alsop, L. E. 06041

Gottfried, David. *See* Anderson, A. T. 06044

06134 **Graf, William L.** The geomorphology of the glacial valley cross section: Arctic and Alpine Research, v. 2, no. 4, p. 303-312, illus., tables, 1970.

Several alpine valley systems in the southeastern Beartooth Mountains, Montana and Wyoming, have been examined using techniques similar to methods of stream system analysis. The general equation $y = ax^b$ is the most adequate mathematical model for the cross valley profile; b values range between 1.5 and 2.0, indicating a parabolic form. As intensity of erosion increases in the glacial valley system, the b value also increases, indicating relatively deeper and narrower valley cross sections. The law of stream numbers, the law of stream lengths, and the bifurcation ratio, derived from fluvial geomorphology, are also applicable in glacial geomorphology. — Author's abstract

Graham, A. L. *See* Mason, Brian. 06135

Graham, A. R. *See* Mitchell, G. P. 05949

Grant, R. W. *See* Housley, R. M. 06286

Graves, R. W., Jr. *See* Akin, R. H., Jr. 06138

Greaves, C. *See* Burns, Roger G. 06082

05808 **Greeley, Ronald.** Note on a specimen collecting sieve: Jour. Paleontology, v. 44, no. 6, p. 1132-1133, illus., 1970.

A sieve easily constructed of wood, vinyl screen, and hardware cloth is effective in collecting marine specimens from sand substrates in shallow water, and fossils from unconsolidated sediments in localities near water. — REG

Greene, H. Gary. *See* Scholl, David W. 05962

05941 **Greenland, L. Paul.** An equation for trace element distribution during magmatic crystallization: Am. Mineralogist, v. 55, nos. 3-4, p. 455-465, illus., 1970.

Unlike previous models for the equilibrium distribution of elements between liquid and solid during crystallization, the general equation developed here can take account of variations in mineral proportions and in distribution coefficients. Several examples demonstrate the use of the equation and illustrate the magnitude of the errors involved in the assumptions of constant distribution coefficients and constant mineral proportions. The equation is expected to be of particular use to the petrologist wishing to relate individual samples of a suite to the degree of crystallization of the magma. — Author's abstract

05910 **Greenlee, David W.** Paleozoic history of the Diablo Platform south of Van Horn, Texas [abs.], *in* The geologic framework of the Chihuahua tectonic belt — Symposium in honor of Ronald K. De Ford, Midland, Tex., 1970: Midland, Tex., West Texas Geol. Soc., p. 28-29, 1970.

06279 **Greenman, Norman N.; Gross, H. Gerald.** Luminescence studies of Apollo 11 lunar samples, *in* Apollo 11 Lunar Sci. Conf., Houston, Tex., 1970, Proc. — V. 3, Physical properties: New York, and Oxford, England, Pergamon Press (Geochim. et Cosmochim. Acta Supp. 1), p. 2155-2161, illus., tables, 1970.

Luminescence measurements with ultraviolet excitation were made of four Apollo 11 lunar rocks, two terrestrial rocks (granite and gabbro), and one terrestrial mineral (willemite) by comparing the spectral curves with the curve of a barium sulfate standard. Upper limits of the efficiency in the 4000-6000 A band with 3000 A excitation were between 5×10^{-6} and 2×10^{-5} for the lunar samples, 2×10^{-3} for gabbro, 6×10^{-4} for granite, and 2×10^{-2} for willemite. If these are typical values for other ultraviolet excitation wavelengths, the Apollo 11 site appears to contribute little to the reported lunar luminescence. Preliminary results with excitation by the hydrogen glow discharge spectrum from the far ultraviolet through the visible, which included the Lyman-alpha line at 1216 A, indicated that possible luminescence in the ultraviolet was produced both as strong lines and as groups of lines. — Authors' abstract

06127 **Greenwood, E.** Oil and gas possibilities in the Chihuahua area [summ.], *in* The geologic framework of the Chihuahua tectonic belt — Symposium in honor of Ronald K. De Ford, Midland, Tex., 1970: Midland, Tex., West Texas Geol. Soc., p. 62-68, illus., 1970.

06280 **Greenwood, N. N.; Howe, A. T.** Mössbauer studies of Apollo 11 lunar samples, *in* Apollo 11 Lunar Sci. Conf., Houston, Tex., 1970, Proc. — V. 3, Physical properties: New York, and Oxford, England, Pergamon Press (Geochim. et Cosmochim. Acta Supp. 1), p. 2163-2169, illus., tables, 1970.

The Mössbauer spectrums of lunar fines (10084-13), obtained at 290°, 80°, and 5°K, established the presence of essentially stoichiometric ilmenite, $FeTiO_3$; iron (II) in tektites (glasses), clinopyroxenes, and olivines; metallic iron; and troilite. The spectrums, originally run in vacuum, did not alter after prolonged exposure to air. Magnetic separate 10084-135 contains nearly twice as much metallic iron but is otherwise similar to the bulk fines, suggesting that the iron is finely interspersed throughout the samples. The microbreccia 10046-46 has somewhat less metallic iron; the paramagnetic resonance spectrums of ilmenite and the silicate minerals are similar to that of the fines but much sharper, suggesting less variation in composition of the silicate phases and a lower tektite concentration. There was no evidence of hematite or pyrrhotite in any of the samples. — DBV

Greenwood, William. *See* Fryxell, Roald. 06276

Greer, R. T. *See* Nash, D. B. 06291

05915 **Gries, John C.; Haenggi, Walter T.** Structural evolution of the eastern Chihuahua tectonic belt [summ.], *in* The geologic framework of the Chihuahua tectonic belt — Symposium in honor of Ronald K. De Ford, Midland, Tex., 1970: Midland, Tex., West Texas Geol. Soc., p. 46-48, illus., 1970.

05945 **Grieve, R. A. F.; Fawcett, J. J.** The synthesis of chloritoid at low pressures: Am. Mineralogist, v. 55, nos. 3-4, p. 517-521, illus., tables, 1970.

At oxygen fugacities along the Ni-NiO buffer, triclinic chloritoid has been synthesized from oxide mixes at water pressures between 8.7 kbar and 1 kbar and at temperatures between 650°C and 525°C, respectively. The data indicates that the 7 A chlorite assemblage, previously considered to be the low pressure metastable equivalent of chloritoid, is unstable with respect to chloritoid. — Authors' abstract

06435 **Griffin, Villard S., Jr.** Relevancy of the Dewey-Bird hypothesis of cordilleran-type mountain belts and the Wegmann stockwork concept: Jour. Geophys. Research, v. 75, no. 35, p. 7504-7507, illus., 1970.

The Dewey-Bird model for cordilleran-type mountain belts (J. F. Dewey and J. M. Bird, 1970) brings together the concept of the new global tectonics and the older stockwork tectonic concept of C. E. Wegmann (1935) for the development of mountain belts. Now geologists have the beginnings of a complete working hypothesis leading to a precise explanation of mountain building in some mobile belts. The southern crystalline Appalachians may be useful as a proving ground for rigorously testing this concept. — Author's abstract

Gromme, C. Sherman. *See* Doell, Richard R. 06275

Gross, H. Gerald. *See* Greenman, Norman N. 06279

06281 **Grossman, J. J.; Ryan, J. A.; Mukherjee, N. R.; Wegner, M. W.** Microchemical, microphysical and adhesive properties of lunar material, *in* Apollo 11 Lunar Sci. Conf., Houston, Tex., 1970, Proc. — V. 3, Physical properties: New York, and Oxford, England, Pergamon Press (Geochim. et Cosmochim. Acta Supp. 1), p. 2171-2181, illus., 1970.

Sample 10065-33 exhibited a time dependent adhesion when cleaved in ultrahigh vacuum. Local electrostatic fields oriented 100 μ particles on the cleaved interface. Disruption of soil samples was observed after exposure to O_2 and O_2-H_2O mixtures. Chemical etching revealed twinning, plastic deformation in some samples, adhesion possibly due to impact melting in others, dislocations at crystalline boundaries, and cosmic ray tracks. — Authors' abstract

06118 **Grow, John A.; Atwater, Tanya.** Mid-Tertiary tectonic transition in the Aleutian Arc: Geol. Soc. America Bull., v. 81, no. 12, p. 3715-3721, illus., 1970.

The present lack of volcanic activity in the western Aleutian Arc correlates with the lack of underthrusting at the western Aleutian trench predictable by plate tectonic theory. A simple plate model allows one to predict that another plate (Kula plate) and a spreading ridge (Kula ridge) lay south of the arc in early Tertiary time and that the Aleutian trench consumed the ridge in the middle Tertiary. Early Tertiary volcanism in the western Aleutians may be related to underthrusting by the Kula plate. A mid-Tertiary orogeny in the central Aleutians and a late Tertiary orogeny in Alaska may be related to the subduction of the Kula ridge. — Authors' abstract

Gude, Arthur J., 3d. *See* Sheppard, Richard A. 06308

Guerrero-Garcia, Jose. *See* Cordoba, Diego A. 05913

06442 **Gupta, M. C.; MacFarlane, R. D.** The natural alpha radioactivity of samarium: Jour. Inorganic and Nuclear Chemistry, v. 32, no. 11, p. 3425-3432, illus., table, 1970.

The half-life and alpha particle energy of Sm-147 have been remeasured using a high resolution cylindrical ionization chamber. The alpha decay of Sm-148 has been detected and the results are consistent with those obtained independently by Korolev. Alpha decay from Sm-146 and Sm-149 was not observed. The results for Sm-148 and Sm-149 are not in agreement with those obtained by Karras. — Authors' abstract

06465 **Gurbuz, B. M.** A study of the Earth's crust and upper mantle using traveltimes and spectrum characteristics of body waves: Seismol. Soc. America Bull., v. 60, no. 6, p. 1921-1935, illus., tables, 1970.

The velocity distribution and structure of the crust and upper mantle were investigated on the basis of close collaboration of theory and experimental results of traveltimes and spectrum characteristics of body waves. Seismic records obtained from "Project Early Rise" in July 1966 were used. A model was constructed and its validity tested by comparing observed traveltimes, spectrum-amplitude ratios, and relative phase shifts of body waves with theoretical values. Evidence is given for three crustal discontinuities with velocities of 6.11 ± 0.01, 6.8 ± 0.08, and 7.10 ± 0.04 kmps at average depths of 18 ± 2 and 25.5 ± 0.9 km. Velocities in the uppermost mantle were 7.90 ± 0.05 and 8.84 ± 0.05 kmps with interfaces at average depths of 34 ± 1 and 47 ± 1 km, respectively. — DBV

06390 **Guy, Harold P.; Ferguson, George E.** Stream sediment, an environmental problem: Jour. Soil and Water Conserv., v. 25, no. 6, p. 217-221, illus., tables, 1970.

Soil and organic sediment from construction sites has a short-term but lasting effect on channel shape and aquatic environment downstream from sites. This article discusses natural and man-made sources of erosion, especially urban construction sites, and their effect on the environment. Two case histories of highway and residential construction in the Potomac River basin are given. The sediment source was studied and movement and deposition measured in order to estimate the total load removed from each site and deposited in the Potomac River. Precipitation and runoff played a large role. To define the nature and magnitude of an erosion problem and plan for its prevention, abatement, or control, detailed information on the source, movement, and deposition of sediment is needed. — EH

Haenggi, Walter T. *See* Gries, John C. 05915

Haenggi, Walter T. *See* DeFord, Ronald K. 05919

06282 **Hafner, Stefan S.; Virgo, David.** Temperature-dependent cation distributions in lunar and terrestrial pyroxenes, *in* Apollo 11 Lunar Sci. Conf., Houston, Tex., 1970, Proc. — V. 3, Physical properties: New York, and Oxford, England, Pergamon Press (Geochim. et Cosmochim. Acta Supp. 1), p. 2183-2198, illus., tables, 1970.

The nuclear hyperfine splittings of Fe-57 in clinopyroxenes from two medium-grained lunar igneous rocks were investigated, with complementary studies of ortho- and clinopyroxenes from terrestrial rocks. It was found that the cation distributions in Ca-rich pyroxenes are principally ordered, Ca occurring predominantly at the M2 sites and Mg at the M1 sites. An equilibrium temperature less than 675°C is indicated, comparable to the approximately 480°C observed in terrestrial orthopyroxenes from granulite facies and intrusive igneous rocks and contrasting with the 600°-720°C of orthopyroxenes from rapidly quenched Hawaiian volcanic rocks. There is a large apparent discrepancy between equilibrium temperatures derived from the Fe^{2+}, Mg exchange reaction with the pyroxene phase and those from the oxygen isotope ratios between mineral phases in medium-grained lunar rocks; this may be due to the absence of an intergranular aqueous phase during the subsolidus history which may critically affect the activation energy for oxygen exchange. — DBV

Hait, M. H. *See* Shoemaker, E. M. 06294

05796 **Hales, A. L.; Helsley, C. E.; Nation, J. B.** Crustal study on Gulf coast of Texas: Am. Assoc. Petroleum Geologists Bull., v. 54, no. 11, p. 2040-2057, illus., tables, 1970.

A Gulf coast onshore-offshore seismic refraction experiment, made along long 94° W., indicates the crust is about 49 km thick beneath Texas, about 33 km beneath the shelf, and about 27 km thick beneath the subshelf. Low-velocity (1.9-3.3 kmps) sediments, about 10 km thick on the shelf, thin both to the north and to the south. The fact that the crust beneath the shelf is thinner than the crust beneath the land suggests that "shallow water" Gulf coast sediments were deposited finally in water of moderate depth, rather than on a normal (subsiding) continental crust. Perhaps the boundary between the thick and thin crusts was once the boundary of the continent, and sediments initially deposited in shallow water were subsequently conveyed to moderately deep water by a turbidity-current-like process. — BHK

06383 **Hamilton, J. B.; Barnette, D. E.** Gypsum in New Brunswick: New Brunswick Dept. Nat. Resources Mineral Resources Br. Rept. Inv. 10, 62 p., illus., tables, geol. map, 1970.

Extensive deposits of evaporites including gypsum, anhydrite, halite and glauberite occur in Lower Carboniferous rocks of New Brunswick. Economic quantities of gypsum are present in the Mississippian Windsor Group. About 100,000 tons per year are produced in the Hillsborough area of Albert County. In the Moncton and Cumberland subbasins sulfates occur largely as anhydrite. Gypsum occurs as a crust of variable thickness lying upon and derived from the anhydrite. In the Plaster Rock subbasin the sulfate occurs as gypsum. Gypsum-anhydrite deposits are classified as massive, laminated, nodule-bearing, and disseminated. The first three are present in the Moncton and Cumberland subbasins. Disseminated gypsum is present at Plaster Rock. — *from* Authors' abstract

05849 **Hardy, Ronald G.** Inventory of industrial, metallic, and solid-fuel minerals in Kansas: Kansas Geol. Survey Bull. 199, pt. 5, 30 p., illus., tables, 1970.

Kansas ranks among the upper one-quarter of the states in the U.S. in the value of mineral production. This report summarizes the type, location, and use of: principal industrial minerals such as limestone, clay, and gravel; metallic minerals; and solid fuels (coal and lignite) in Kansas. Resources of crude oil, natural gas, and water are treated extensively in other Survey publications. — Author's abstract

06132 **Harington, C. R.** A postglacial muskox (*Ovibos moschatus*) from Grandview, Manitoba, and comments on the zoogeography of *Ovibos* [with French abs.]: Canada Natl. Mus. Nat. Sci. Pubs. Palaeontology, no. 2, 13 p., illus., table, 1970.

A cranial fragment of a muskox from a gravel deposit near Grandview, southwestern Manitoba, has been radiocarbon dated at 8,620 ± 190 years B.P. Craniometric comparisons show that the specimen is referable to *Ovibos moschatus*, which survives in Arctic Canada and Greenland. *Ovibos*, a tundra-adapted animal, evidently first entered North America from Eurasia during the Illinoian glaciation, and apparently survived the Wisconsin glaciation in a Western Arctic Islands refugium, a Beringian refugium, and a refugium south of the Wisconsin ice. It is postulated that the Grandview specimen represents muskox herds that moved north from the southern refugium, following the tundra zone that bordered the backmelting Wisconsin ice, until they reached their present range on the Northwest Territories mainland. — *from* Author's abstract

06461 **Harkrider, David G.** Surface waves in multilayered elastic media — Pt. 2, Higher mode spectra and spectral ratios from point sources in plane layered earth models: Seismol. Soc. America Bull., v. 60, no. 6, p. 1937-1987, illus., tables, 1970.

Phase and amplitude spectra of Rayleigh and Love waves are presented for two Earth models, one oceanic and one continental shield. The spectra of the first three Rayleigh modes and the first four Love modes are tabulated for point sources at selected depths. These tables along with computer algorithms described here allow one to estimate the amplitude spectra at nontabulated source depths. The use of spectral ratios as a means of determining source depth is investigated. A source depth of 20 km is obtained for the Fallon earthquake of July 20, 1962. This depth agrees with previous estimates, but the technique requires a fault-plane orientation which differs from radiation pattern solutions. — Author's abstract

00024 **Harries, D. A.** Mexico — Constructing the deep level drainage system of Mexico City: Tunnels and Tunnelling, v. 3, no. 1, p. 35, 37-42, illus., 1971.

The high Valley of Mexico surrounded by extinct volcanoes has long had drainage problems. An early tunnel project, disrupted by landslides in 1631, was converted to an open cut finished in 1789. Grand Canal completed in 1900, for a population of 500,000, now serves 7.5 million and drains lower city land on a deep fill of old lake beds. Random wells in aquifers 100 m deep caused subsidence of 7 m to increase overload problems; underground tanks hold excess run-off, and 29 pumping stations lift sewage and storm waters from trunk lines. In a hard layer above repeated sand layers and volcanic ash lies the new deep tunnel, its outfall traverses a variety of formations and is in part driven through volcanic outwash fans. Progress of this project and solutions to problems are discussed. — GDC

06393 **Hartung, Jack B.; Short, Nicholas M.; Adams, John A. S.** Potassium-argon analysis of rocks shocked by nuclear explosions: Modern Geology, v. 1, no. 4, p. 279-281, table, 1970.

No radiogenic argon loss was detected from feldspars shocked below 200 kilobars and cooled quickly. Shock-isopropized feldspars that were cooled quickly lost approximately 25 percent argon. Feldspars subjected to less shock but more severe postshock heating lost even more argon. Nearly total argon loss occurred from a partially recrystallized feldspar sample that was shocked intensely and remained hot near the underground puddle of melted rock. All but the one most intensely shocked of the biotite separates analyzed lost essentially no radiogenic argon. The intensity of the shock event and the degree of postshock heating are both factors contributing to the argon losses observed. — Authors' abstract

05853 **Harvey, Richard D.** Petrographic and mineralogical characteristics of carbonate rocks related to sorption of sulfur oxides in flue gases: Illinois Geol. Survey Environmental Geology Note 38, 31 p., illus., tables, 1970.

Detailed petrographic, mineralogical, and chemical analyses of two limestones, two calcite spars, an oolitic aragonite sand, four dolomites, and a magnesite were made and compared with their relative capacity for sorption of sulfur dioxide. Imperfect calcite spar sorbed twice as much SO_2 as the Iceland spar; oolitic aragonite sorbed the most and magnesite the least. Temperature of the test, 1800°F, may have been too high for maximum sorptive capacity of magnesite. Linear regression analyses of test data show that as the log of Na content increases SO_2 sorption increases. Certain petrographic parameters show correlations with sorption. Capacity of the limestone, dolomite, and calcite samples increases with volume of pores greater than 1μ in diameter. For all samples except magnesite, SO_2 sorption capacity increases with decreasing mean grain size. — *from* Author's abstract

00013 **Hatheway, R. B.** Evidence for major faulting in south-central Maine: Geol. Soc. America Bull., v. 82, no. 1, p. 253-257, illus., 1971.

Field evidence strongly suggests that south-central Maine is the locus of a major northeast-trending fault zone. Severe faulting has occurred in the Casco Bay, Bath, and Wiscasset quadrangles as indicated by: (1) the presence of mylonites and other cataclastic rocks; (2) an abrupt change in metamorphic intensity; (3) an offset of metamorphic isograds; and (4) a displacement of the axis of the major structural feature through Wiscasset, an antiform. Crustal movement on this 70-mi-long fault zone probably took place during the late stages of the Acadian orogeny, in Late Devonian time. — Author's abstract

00011 **Hawkins, James W.; Allison, Edwin C.; MacDougall, Doug.** Volcanic petrology and geologic history of Northeast Bank, southern California borderland: Geol. Soc. America Bull., v. 82, no. 1, p. 219-227, illus., table, 1971.

Basaltic rocks dredged from Northeast Bank consist of fossiliferous hyaloclasites, agglomerates, and flows. Fission track and K-Ar dates average about 4.5 m.y. Fossil fragments indicate as much as 500 m subsidence since volcanism. Isostatic adjustments due to crustal load of the bank can account for this subsidence. The positive

magnetic anomaly due to the bank lies on the projected trend of sea floor anomaly 5 c (16 m.y. old) of the Mason-Raff lineations. Inasmuch as the age of Northeast Bank is about 4.5 m.y., the projection of sea-floor magnetic trends into the California borderland area seems very unlikely. — HCW

Hayley, D. W. *See* Brooker, E. W. 05979

Hays, James Fred. *See* Beger, Richard M. 06056

Heard, H. C. *See* Borg, I. Y. 06121

Hedge, C. E. *See* Goldich, S. S. 05965

06365 **Heerden, J. van.** The taxonomic value of spiral accessory apertures in some Tertiary taxa [with Spanish abs.]: Rev. Espanöla Micropaleontología, v. 2, no. 2, p. 165-172, illus., 1970.

In a well-preserved fauna of middle Eocene planktonic foraminifers from southeastern Spain, a few specimens of *Globigerina yeguaensis* Weinzerl and Applin 1929 and *Globorotalia spinulosa* Cushman 1927 have supplementary sutural apertures on the spiral side; most specimens do not show such apertures, nor did either species as originally described (Eocene, Gulf coast and West Indies). Moreover, most specimens of *Truncorotaloides rohri* in the sample lack such apertures, although the feature was diagnostic of the genus (Bronnimann and Bermudez, 1953, Eocene, Trinidad). A survey of literature turns up many examples of supplementary spiral apertures as an intraspecific feature in globigerinaceans; it is suggested that *Truncorotaloides* be withdrawn, as it does not otherwise differ from *Globorotalia* or *Turborotalia*. — VMJ

Heiken, Grant. *See* Fryxell, Roald. 06276

06116 **Heinrich, E. William; Moore, D. G., Jr.** Metasomatic potash feldspar rocks associated with igneous alkalic complexes, *in* Alkaline rocks, the Monteregian Hills — Symposium, Montreal, 1969, Proc.: Canadian Mineralogist, v. 10, pt. 3, p. 571-584, illus., table, 1970.

Anchimonomineralic potash feldspar rocks are widespread components of alkalic-carbonatitic complexes, and are generally older. They occur as units within complexes, in wall rocks adjacent to complexes, and as veins, dikes, pipes, and linear zones apart from complexes. In addition to disseminated hematite, they may contain concentrations of rare earths and thorite. Feldspars are turbid, rarely show gridiron twinning, may have relict cores of clear, older feldspar, and contain usually less than five mole percent albite. Further evidence of low-temperature genetic environment is the co-presence of chalcedony, opal, and Schachbrett albite, and associated fluorite, barite, and quartz crystals. The rocks were formed by potash metasomatism, and are replacements or variants of fenites, representing a high-level type of alteration associated with complexes displaying sub-volcanic or hypabyssal characteristics. — *from* Authors' abstract

Helsley, C. E. *See* Hales, A. L. 05796

06283 **Helsley, Charles E.** Magnetic properties of lunar 10022, 10069, 10084 and 10085 samples, *in* Apollo 11 Lunar Sci. Conf., Houston, Tex., 1970, Proc. — V. 3, Physical properties: New York, and Oxford, England, Pergamon Press (Geochim. et Cosmochim. Acta Supp. 1), p. 2213-2219, illus., 1970.

Thermomagnetic investigations of 20- to 80-mg portions of the rock samples and the -150 mesh fraction of the lunar dust show pronounced Curie points between 680° and 780°C. Remanent intensities of the five rock fragments vary from 8.4×10^{-5} to 0.30×10^{-5} e.m.u./g. Upon demagnetization, two of the samples had only viscous magnetization and the other three samples had stable magnetizations with remanent coercivities in excess of 50 oe. Partial thermal demagnetization suggests that these apparently stable moments may have been acquired in a magnetic field in excess of 1500 gammas. — Author's abstract

06223 **Henderson, Bonnie C.** Student enrollment in earth science, 1969-70: Geotimes, v. 15, no. 10, p. 16-19, illus., tables, 1970.

Results of the American Geological Institute's survey of student enrollment in geoscience departments for the academic year 1969-70 are presented under the following topics: those in degree programs, nonmajor Earth-science students, enrollment vs. degrees granted, annual starting salaries, comments on employment prospects, how interdisciplinary trends affect enrollment data, and precision of the survey. — ESL

05836 **Henisch, Heinz K.** Crystal growth in gels: University Park, Pa., and London, England, Pennsylvania State Univ. Press, 111 p., illus., 1970.

This text for chemists, physicists, and materials scientists provides a detailed analysis of an inexpensive and versatile technique for research on many substances that have not been grown before in single crystal form. Chapter headings are: history and nature of the gel method, gel structure and properties, growth mechanisms and characteristics, nucleation, and problems solved and unsolved. Supplementary notes and an index are appended. — MCM

06348 **Henriksen, N.; Jepsen, H. F.** K/Ar age determinations on dolerites from southern Peary Land, *in* Report of activities, 1969: Grönlands Geol. Undersögelse Rap. 28, p. 55-58, 1970.

Unfolded Precambrian sandstones with discordant mafic sills underlie in erosional unconformity an Eocambrian sequence with tillite at the base; above these is the Brönlund Fjord Dolomite cut by dolerite dikes. The pre-tillite sandstones are correlated in Kronprins Christian Land with geosynclinal upper Thulean beds, folded and metamorphosed by Carolinidian orogeny, faults of its final stage connected with post-orogenic dikes. Older intrusions are mainly sills; their correlation with those in southern Peary Land is not proven. From the Jörgen Brönlund Fjord-Midsommersö area, dolerites of two Precambrian discordant sills were K-Ar dated at about 988 m.y. and about 799 m.y., and one post Lower Cambrian dike at about 72.2 m.y. (Late Cretaceous). It is concluded that pre-tillite sandstones of southern Peary Land and corresponding upper beds of the geosyncline are at least 1000 m.y. old; orogeny age is in range 1000-800 m.y. — GDC

06253 **Henriksen, Niels.** Field mapping in the Scoresby Sund area, East Greenland, *in* Report of activities, 1969: Grönlands Geol. Undersögelse Rap. 28, p. 39-41, 1970.

The second season's expedition, based on the polar vessel "Magga Dan," included 15 two-man geological parties: seven in the Caledonian crystalline complex of outer Nordvestfjord; two in crystallines in Liverpool Land; one in Tertiary basalt near Hall Bredning; one in Quaternary features on Milne Land and western Jameson, and one in special geochronological investigations on Björneöer; the last three mapped Upper Paleozoic and Mesozoic of Jameson Land. The crystalline complex, east of that mapped in 1968, becomes more intensely metamorphosed, ultimately granitized; transition gneisses are banded with pre-migmatitic remnants. In the first phase of deformation, flat folds dominate, particularly in Liverpool Land; the second phase, folding with vertical axial planes formed open N-S-trending forms. North of outer Norvestfjord, post-kinematic granites intrude older migmatites. — GDC

Henry, Vernon J., Jr. *See* Hoyt, John H. 00004

05879 **Herdendorf, Charles E.** Lake Erie physical limnology cruise, midsummer 1967: Ohio Div. Geol. Survey Rept. Inv. 79, 77 p., illus., tables, 1970.

The Ohio Division of Geological Survey research vessel GS-1 cruised over 500 miles from Lake Saint Clair to Niagara River, making 13 transects across lake and connecting waterways. A series of 100 stations was established along the transects, and probe measurements of water properties made at each station; current measurements were made and water and bottom deposit samples were taken at about half the stations. Topics of geological interest discussed are: physico-chemical measurements, and sediment sampling and depth sounding. Areas of deposition and of erosion are

delineated. Limnology of western Lake Erie is strongly influenced by Detroit River flow composed of three water masses. Midlake water in the central and eastern basins is relatively uniform and of good quality. — ESL

06284 **Herzenberg, C. L.; Riley, D. L.** Analysis of first returned lunar samples by Mössbauer spectrometry, *in* Apollo 11 Lunar Sci. Conf., Houston, Tex., 1970, Proc. — V. 3, Physical properties: New York, and Oxford, England, Pergamon Press (Geochim. et Cosmochim. Acta Supp. 1), p. 2221-2241, illus., tables, 1970.

Nuclear gamma resonance measurements for the nuclide Fe^{57} in lunar material have been made in transmission on lunar fines at 300°K and 80°K and in scattering on intact lunar rock chips at 300°K. Analyses of the fines spectra lead to the conclusion that the fines contain approximately 12 wt. percent iron, distributed as follows: 73 percent in the silicate phases (including iron-bearing glasses, pyroxenes and olivine), 19 percent in ilmenite, 5 percent in metallic iron and 1 percent in troilite. No ferric iron was detected in either the fines or the lunar rocks. The major phases detected in all lunar crystalline rocks were ilmenite and pyroxene. In addition, the microbreccia contained iron-bearing glasses and a greater abundance of metallic iron. Exposed surfaces of lunar rocks exhibited spectra similar to those of interior surfaces. No reaction of lunar material with the atmosphere was detected. — Authors' abstract

Hess, John W. *See* Brucker, Roger W. 06075

Hester, N. C. *See* Bradbury, J. C. 06321

05854 **Hester, Norman C.; Labotka, Theodore C.** An investigation of sands on the uplands adjacent to the Sangamon River floodplain — Possibilities as a "blend sand" resource: Illinois Geol. Survey Indus. Minerals Note 42, 10 p., illus., tables, 1970.

This investigation found an abundant supply of clean, medium-grained sand forming hills on the upland along the floodplain in Macon and Cristian Counties. Most samples tested were too coarse to meet the requirements for blend sand, an important constituent of bituminous mixtures used in road surfacing. Distribution of the sands north and south of the river and size analyses suggest that most were deposited by water and reworked by wind. Further exploration should be concentrated on topographic highs south of the floodplain. — *from* Authors' abstract

05828 **Higgins, Michael W.; Crowley, William.** Metavolcanic rocks and epizonal plutons in the Cecil County Piedmont, Maryland — Field trip introduction, first day, and road log, *in* New interpretations of eastern Piedmont geology of Maryland, *or* granite and gabbro or graywacke and greenstone?—35th Ann. Field Conf. Pennsylvania Geologists, 1970, Guidebook: Harrisburg, Pa., Pennsylvania Topog. and Geol. Survey, *also* Baltimore, Md., Maryland Geol. Survey, p. 5-36, illus., table, 1970.

Metavolcanic rocks underlie more of Cecil County Piedmont than previously supposed; basalt to rhyolite in composition, they range from pillowed subaqueous flows to ash falls, some mixed with detrital sedimentary material, and grade by increasing grain size and slight mineralogic changes into shallow, coeval plutonic rocks that were probably sources for the volcanic rocks. This part of the field conference concentrates on two of the more interesting and accessible examples of parts of this assemblage: a unit of pillow basalt, basaltic tuff, and pillow breccia, metamorphosed and locally sheared into amphibole schist and layered amphibolite; and the Port Deposit pluton, restricted in size by recent mapping. The metabasalt unit is divisible into four stratigraphic parts. Geology is described at six of the seven stops (two in Harford County); at Stop 4, near Conowingo dam, comments on the archeology of northeastern Maryland are offered by Tyler Bastian. — GDC

05814 **Hill, Mary R.** "Mount Lassen is in eruption and there is no mistake about that": California Div. Mines and Geology Mineral Inf. Service, v. 23, no. 11, p. 211-224, illus., 1970.

This popular account of the 1914-19 activity on Lassen Peak, Calif., consists of eyewitness stories, and is illustrated by both before and after pictures and successive

views of eruptions. Phenomena described include a great mudflow and a nuee ardente in 1919. — ESL

Hinsch, Gertrude W. *See* Mueller, George. 06301

06310 **Hobson, George D.** A hammer refraction seismic survey, Catamaran Brook area, McKendrick Lake, New Brunswick, 21 J/16 east half, App. A, *in* Geology of McKendrick Lake map-area, New Brunswick: Canada Geol. Survey Paper 69-12, p. 11-16, illus., 1970.

A hammer-seismic survey was conducted along four lines immediately south of Catamaran Brook in Southesk Parish; 53 single direction refraction seismic profiles were completed. Only two reverse profiles were surveyed. Observed seismic velocity versus frequency of occurrence is shown on a histogram. Conglomerate and graywacke formations can be differentiated on the basis of velocity — < 13,000 ft per sec for the former and > 13,000 ft per sec for the latter. Thickness of overburden varies between about 4 feet and a maximum of 84 feet. Significant relief, obvious on top of the graywacke basement, is clearly a pre-Carboniferous feature present at time of conglomerate deposition. Indicated within the basement are faults or changes in gross lithology; no fault is present in the conglomerate body, which is like a filled shallow trough trending NE that wedges out to the southeast. — GDC

06305 **Hoggan, Roger D.** Paleontology and paleoecology of the Curtis Formation in the Uinta Mountains area, Daggett County, Utah: Brigham Young Univ. Geology Studies, v. 17, pt. 2, p. 31-65, illus., 1970.

The Oxfordian Curtis Formation represents the last advance of epeiric seas into Utah during Late Jurassic. A measured section near Flaming Gorge Reservoir, exposes two members in the Curtis; the lower, about 69 feet thick, consists of glauconitic calcareous siltstone, sandstone, and noncalcareous shale deposited in a neritic environment. The upper member, deposited in a littoral environment, consists of 82 feet of oolitic and sandy limestone with well-developed crossbedding and ripple marks. Sea level was lowering at this time. In the lower member, casts and molds of pelecypods are present in most beds, belemnites are common, ammonites are present but rare, and a number of microfossils are found. Rhynchonellid brachiopods are present throughout the upper member. Some pelecypods, gastropods, and crinoid ossicles are also present. — *from* Author's abstract

00036 **Holloway, John R.** Composition of fluid phase solutes in a basalt-H_2O-CO_2 system: Geol. Soc. America Bull., v. 82, no. 1, p. 233-237, illus., tables, 1971.

Mixtures consisting of 50 weight percent of 1921 Kilauea basalt, 16 percent H_2O, and 34 percent CO_2 were equilibrated at 800°, 900°, 1000° and 1100°C and 2, 5, and 8 kb. Oxygen fugacity was buffered by Ni + NiO. The fluid phase solute was analyzed for Si, Ti, Al, Fe, Mn, Mg, Ca, Na, K, Ba, and Sr. Total solute content ranges from 0.5 to 2 weight percent of the fluid. It is mostly composed of SiO_2, Al_2O_3, and MgO; total iron is depleted compared to the starting material. The high ratios of Mg/Fe and Mg/Ca and the low total solute content appear to rule out gas transfer as a differentiation mechanism under conditions similar to those of this study. The low solubility of iron may explain magnetite deposits formed at diabase-limestone contacts. — Author's abstract

06303 **Holroyd, M. T.; Bhattacharyya, B. K.** Automatic contouring of geophysical data using bicubic spline interpolation: Canada Geol. Survey Paper 70-55, 40 p., illus., tables, 1970.

A method for automatic contouring of two-dimensional geophysical data is presented in this paper. The method is based on piecewise bicubic spline representation of uniformly-graded data points derived from irregularly-spaced observations. The testing of this method has been carried out with a set of data digitized along flight lines at points of intersection with contour lines on a published aeromagnetic map. The map is conspicuous by the presence of steep gradient as well as broad, smoothly-varying regions. A critical examination of the machine-contoured map with respect to the

published hand-drawn map establishes the accuracy and reliability of the automatic contouring program. In this paper a short account of bicubic splines is followed by a description of the contouring program, the input data required by the program, and the results. — Authors' abstract

06371 **Honjo, Susumu; Tabuchi, Hiroyoshi.** Distribution of some minor elements in carbonate rocks — [Pt.] 1, A list of analytical values of Mg, Sr, Fe, Mn, Zn, Cu, Cr, Ni, and V. Pacific Geology, v. 2, p. 41-79, illus., tables, 1970.

The contents of Mg, Sr, Fe, Mn, Zn, Cu, Cr, Ni, and V in carbonate rocks from various areas in the world, including the Smoky Hill Chalk of Kansas, and upper Paleozoic limestone of Midcontinent United States, are compiled in tables. Brief descriptions are given of the formations. The nine elements tend to decrease in the following order: Fe, Mg, Sr, Zn, Cu, Ni, V, Pb, and Cr. — VSN

06173 **Hooker, Marjorie.** "Catoctin schist" analysis — Its true identity, *in* Geological Survey research 1970, Chap. D: U.S. Geol. Survey Prof. Paper 700-D, p. D106-D107, 1970.

A chemical analysis, published as that of a schist from South Mountain, Pa., is shown to be, in reality, that of a basalt from Madera County, Calif. — Author's abstract

05809 **Hope, R. C.; Patterson, O. F., 3d.** *Pekinopteris auriculata*, a new plant from the North Carolina Triassic: Jour. Paleontology, v. 44, no. 6, p. 1137-1139, illus., 1970.

Pekinopteris auriculata Hope and Patterson is a new genus and species of common fernlike foliage in a newly discovered assemblage of plants in the Upper Triassic Pekin Formation of central North Carolina. Although no fructifications have been found, it is presumed from the delicate laminar texture of the pinnules and from associated circinately coiled young fronds that the plant is a true fern. — SHM

06285 **Horai, Ki-iti; Simmons, Gene; Kanamori, Hiroo; Wones, David.** Thermal diffusivity, conductivity and thermal inertia of Apollo 11 lunar material, *in* Apollo 11 Lunar Sci. Conf., Houston, Tex., 1970, Proc. — V. 3, Physical properties: New York, and Oxford, England, Pergamon Press (Geochim. et Cosmochim. Acta Supp. 1), p. 2243-2249, illus., tables, 1970.

The thermal diffusivity of four Apollo 11 lunar specimens measured over the temperature range -130°C to +150°C is lower than the diffusivity of terrestrial rocks. Breccias (type C material) exhibit lower diffusivities than crystalline igneous rocks (type A). Thermal conductivity and thermal inertia are given as a function of temperature for both types of material. — Authors' abstract

06449 **Hornbrook, E. H. W.** Biogeochemical investigations in the Perch Lake area, Chalk River, Ontario: Canada Geol. Survey Paper 70-43, 23 p., illus., tables, 1970.

Investigations were conducted at an isolated sample plot in the Perch Lake basin to determine the plant sampling density required to evaluate heavy mineral distribution in background areas; to test the field operation of two mobile trailer laboratory units and effects of their transportation; and to examine the feasibility of a biogeochemical and geochemical dispersion experiment. Plant and humus ash and mineral soil were leached with hot nitric acid and Pb, Zn, Mn, Ag, Ni, and Co were determined by atomic absorption spectrophotometry. Heavy metal content is fairly uniformly distributed among plant organ samples collected at 15 stations in the 100- by 120-ft plot. Those collected on 100-ft station intervals will provide satisfactory data to evaluate heavy metal distribution in a background area. Performance of the mobile laboratories was satisfactory, and experiment with dispersion was found to be feasible. — *from* Author's abstract

05803 **Horne, Gregory S.; Johnson, J. Harlan.** Ordovician algae from boulders in Silurian deposits of New World Island, Newfoundland: Jour. Paleontology, v. 44, no. 6, p. 1055-1059, illus., table, 1970.

Limestone boulders near the base of the Silurian Goldson Formation contain corals and calcareous algae of Late Ordovician age. The algae represent four species: *Hedstroemia aequalis*, *Vermiporella canadensis* n.sp., *Rhabdoporella* sp., and *Girvanella problematica*. The flora resembles one from Norway described by Hoeg (1933). — *from* Authors' abstract

06286 **Housley, R. M.; Blander, M.; Abdel-Gawad, M.; Grant, R. W.; Muir, A. H., Jr.** Mössbauer spectroscopy of Apollo 11 samples, *in* Apollo 11 Lunar Sci. Conf., Houston, Tex., 1970, Proc. — V. 3, Physical properties: New York, and Oxford, England, Pergamon Press (Geochim. et Cosmochim. Acta Supp. 1), p. 2251-2268, illus., tables, 1970.

Samples of lunar dust, breccia, and three igneous rocks were studied by Mössbauer spectroscopy and petrographic examination. The mineral fragments in the dust have an average phase composition similar to the rocks and are probably of local origin. The average composition of the glass in the dust corresponds to a 50-50 mixture of local basalt with anorthosite. The original magma of the rocks was in a net reduced state with partial pressure of oxygen somewhat lower than the quartz-fayalite-iron buffer. Most of the ilmenite is stoichiometric and on the average contains only small amounts of geikielite in solid solution. The excess Fe metal in the dust could all be meteoritic iron, but possibly partially from reduction of FeS in rocks and meteorites. Unusual Fe charge states and Fe^{3+} were not found. There was no noticeable reaction of Fe in any of the phases with air at room temperature in a period of two months. — DBV

05999 **Howard, James Hatten, 3d.** Geochemical behavior of selenium in earth-surface environments [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 12, pt. 1, p. 5554B-5555B, 1970.

00014 **Howard, Keith A.** Paleozoic metasediments in the northern Ruby Mountains, Nevada: Geol. Soc. America Bull., v. 82, no. 1, p. 259-264, illus., 1971.

New evidence indicates that high-grade regionally metamorphosed marble and quartzite in the northern Ruby Mountains are Paleozoic strata. Correlation is based on a match of the lithologic sequence to strata of Cambrian to Devonian age in nearby areas; particularly diagnostic is a brown dolomite at the base of the Cambrian carbonate sequence. The metamorphic complex contrasts with unmetamorphosed terranes exposed in nearby areas, and apparently formed in the Mesozoic as part of a metamorphic infrastructure. — Author's abstract

Howe, A. T. *See* Greenwood, N. N. 06280

05869 **Howie, R. D.** Oil and gas exploration — Atlantic coast of Canada: Am. Assoc. Petroleum Geologists Bull., v. 54, no. 11, p. 1989-2006, illus., 1970.

In Quebec, the Atlantic Provinces, and adjacent offshore areas almost all systems are represented. Gas and/or oil shows have been reported from Ordovician, Devonian, Carboniferous, late Mesozoic, and Tertiary rocks. The only commercial production of oil and gas is from lower Carboniferous strata near Moncton, New Brunswick. Offshore geophysical surveys indicate sedimentary thicknesses of 20,000 feet on the outer Labrador shelf, 24,000 feet in the Gulf of St. Lawrence, 20,000 feet on the Scotian shelf, and 18,000 feet on the Grand Banks of Newfoundland. On the Scotian shelf, shallow drillholes, grab samples, and a 15,106-ft well indicate the presence of Quaternary, Tertiary and Cretaceous sedimentary rocks. On Grand Banks, two holes penetrated Tertiary and Cretaceous strata. One well was abandoned in salt at 4,834 feet and the other at 5,250 feet in siltstone. — *from* Author's abstract

06287 **Hoyt, H. P., Jr.; Kardos, J. L.; Miyajima, M.; Seitz, M. G.; Sun, S. S.; Walker, R. M.; Wittels, M. C.** Thermoluminescence, X-ray and stored energy measurements of Apollo 11 samples, *in* Apollo 11 Lunar Sci. Conf., Houston, Tex., 1970, Proc. — V. 3, Physical properties: New York, and Oxford, England, Pergamon Press (Geochim. et Cosmochim. Acta Supp. 1), p. 2269-2287, illus., 1970.

Despite large radiation doses on the Moon, the thermoluminescence of lunar rocks and fines is unsaturated, probably due to thermal draining on the surface. Feldspar is the dominant TL mineral. Distortion effects revealed by X-rays are probably not due to radiation damage. Heating experiments on the < 400-mesh fines support the view that the samples are not heavily radiation-damaged. Six red corundum crystals were identified in core 2 of 10004. Differential thermal analysis in air shows two broad exotherms (< 20 cal per g) below 750°C and a sharper doublet peak from 750°C to 850°C; heating in N_2 eliminates the first peak, reduces the second by 50 percent, and does not affect the third. The X-ray and DTA results are consistent with what is known of the radiation history of the samples. — DBV

00004 **Hoyt, John H.; Henry, Vernon J., Jr.** Origin of capes and shoals along the southeastern coast of the United States: Geol. Soc. America Bull., v. 82, no. 1, p. 59-66, illus., 1971.

The origin of the prominent capes and shoals along the southeastern coast has not been satisfactorily explained. Previously proposed mechanisms, including back-set eddies of the Florida Current (Gulf Stream), longshore-offshore drift, structural uplift, and variations in wave incidence, are improbable because of the concentration of wave energy on headlands. Wave refraction favors the retreat of headlands, and an alternate hypothesis for the origin of the capes and offshore shoals must be considered. The locations of the capes correspond with the discharge areas of major rivers, either at the present or during the Pleistocene. The capes are explained as post-glacial modifications of Pleistocene deltas by submergence and retreat of barrier capes. — Authors' abstract

05971 **Hoyt, John H.** Development and migration of barrier islands, northern Gulf of Mexico — Discussion [of paper by E. G. Otvos, Jr., 1970]: Geol. Soc. America Bull., v. 81, no. 12, p. 3779-3782, 1970.

For the paper under discussion, *see* ibid., v. 81, no. 1, p. 241-246, 1970; Abs. North American Geology, June 1970.

06431 **Hriskevich, Michael E.** Middle Devonian reef production, Rainbow area, Alberta, Canada: Am. Assoc. Petroleum Geologists Bull., v. 54, no. 12, p. 2260-2281, illus., 1970.

Intensive exploratory effort in this area resulted in finding an estimated 2.2 billion bbl oil and 1.5 trillion cu ft gas. Main producing unit is the Rainbow Member of the Keg River Formation; discoveries have also been made in several younger units. Unique events during the history of exploration and production include: 1) adaptation of Common Depth Point seismic technique to find carbonate reefs within an evaporite sequence; 2) first year-round seismic and drilling operations in the muskeg terrane of northwestern Alberta; 3) detailed studies of reef cores to aid in evaluation of secondary recovery schemes using one-, two-, and three-dimensional mathematical models constructed to simulate movement of fluids in the producing formation. Prospects for hydrocarbon production from reefs of several ages in this part of western Canada sedimentary basins are considered excellent. — EGS

06456 **Hu, Chung-Hung.** The ontogenies of *Ponumia obscura* (Lochman), n.g., and of *Housia canadensis* (Walcott) (Trilobita) from the Upper Cambrian of the Big Horn Mountains, Wyoming [with Japanese abs.]: Palaeont. Soc. Japan Trans. and Proc., new ser., no. 78, p. 253-264, illus., 1970.

Ontogenies are described for two ptychoparioid trilobites (suborder Ptychopariina) from the *Elvinia* zone in the Flatland Formation (Franconian) of the Big Horn Mountains in north-central Wyoming. Adults of both species are present in the same samples. For *Housia canadensis* (Housiidae, Dikelocephalacea), metaprotaspid and early and late meraspid stages are described. *Bynumiella, obscura* Lochman 1964 is made type species of a new genus, *Ponumia*; an unbroken growth sequence is represented by anaprotaspid, metaprotaspid, paraprotaspid, early and late meraspid stages. The family of *Ponumia* is still undetermined, but *Ponumia, Aphelotoxon* Palmer 1965, and *Cliffia* Wilson 1951 may belong to the same taxonomic group (Solenopleuracea). — VMJ

05871 **Huang, Ju-Chang; Liao, Cheng-Sun.** Adsorption of pesticides by clay minerals: Am. Soc. Civil Engineers Proc., v. 96, paper 7603, Jour. Sanitary Eng. Div., no. SA5, p. 1057-1078, illus., tables, 1970.

The rate and equilibrium of adsorptions of DDT, dieldrin, and heptachlor by illite, kaolinite, and montmorillonite from aqueous pesticidal solutions are evaluated. The adsorption of each at an initial concentration of 100 μg/l by kaolinite and illite is nearly instantaneous, the molecules of pesticides being deposited on the clay's surfaces. As montmorillonite is an expansible clay, DDT and heptachlor can also difuse gradually into its interlamellar spaces. The adsorption of DDT and heptachlor is relatively irreversible; however, some dieldrin adsorption occurs. It is concluded that the primary mechanisms of the adsorption of these pesticides by clays are through the formation of hydrogen bondings and some other strong forces of interaction. — *from* ASCE abstract

05793 **Huang, Ter-Chien; Goodell, H. G.** Sediments and sedimentary processes of eastern Mississippi cone, Gulf of Mexico: Am. Assoc. Petroleum Geologists Bull., v. 54, no. 11, p. 2070-2100, illus., tables, 1970.

The upper 6-7 m of sediment of the eastern Mississippi cone consists of silt, silty clay, and fine sand, topped by a 20-50-cm layer of foraminiferal clay. The lower silty layers, deposits of the latest low sea-level stand, were deposited more rapidly than the upper foraminiferal clay. These sedimentation rates average about 30 cm/1,000 yr. None of the sedimentary structures of the deep-sea fan is typical of vertical "turbidity" sequences. The primary mechanisms of sediment transport are differential pelagic settling and low-flow-regime bottom currents with mass movements by slumping in channel and slope areas. Diagenetic solution of carbonate is related to degradation of organic matter in the sediments. The upper cone is indented by digitate leveed valleys cut by transverse ridges, whereas the lower section is smooth. — *from* Authors' abstract

05867 **Huddle, John W.** Revised descriptions of some late Devonian polygnathid conodonts: Jour. Paleontology, v. 44, no. 6, p. 1029-1040, illus., tables, 1970.

The types of *Polygnathus dubius*, *P. pennatus*, *P. decorosus* and *P. ordinatus*, an intergrading species complex, were restudied and are redescribed. *P. foliatus* and *P. rugosus* are regarded as junior synonyms of *P. pennatus* and *P. dubius*. The lectotype of *P. dubius* was lost, and the lectotype of *P. foliatus* is here designated as the neotype of *P. dubius*. Type locality of *P. decorosus* is in the Olentangy Shale of central Ohio; those of the other species are in members of the Genesee Formation of western and central New York. All the species are widely distributed in the late Middle and Upper Devonian (Givetian to Frasnian or Famennian) of North America and Europe. — JWH

06136 **Hudson, Adonnis S.** Depositional environment of the Red Fork and equivalent sandstones east of the Nemaha Ridge, Kansas and Oklahoma: Shale Shaker, v. 21, no. 4, p. 80-95, illus., 1970.

The Lower Pennsylvanian Red Fork and Burbank Sands of Oklahoma, and the "Bartlesville" Sand in the "shoestring sand pools" of southeastern Kansas are primarily a continuous fluvial deposit. In Kansas the sand was deposited in a "valley flat" environment, controlled by northeast-southwest surface structure features on the Mississippian surface. Faulting associated with the Nemaha ridge in south-central Kansas deflected the fluvial channels to the south. A distributary or delta environment on the Cherokee Sea shoreline developed in Osage and Pawnee Counties, Oklahoma. — Author's abstract

Huey, James M. *See* Kohman, Truman P. 06436

Huggins, Frank E. *See* Burns, Roger G. 06083

Hunt, Graham R. *See* Logan, Lloyd M. 06260

06394 **Hunt, Graham R.; Salisbury, John W.** Visible and near-infrared spectra of minerals and rocks — [Pt.] 1, Silicate minerals: Modern Geology, v. 1, no. 4, p. 283-300, illus., 1970.

As part of a laboratory study of spectroscopic remote-sensing techniques, the visible and near-infrared spectral behavior of rocks and minerals has been evaluated. In this first of a series of papers, spectral features displayed by silicate minerals due to electronic transition or molecular vibration phenomena are identified and explained. Subsequent papers in this series will deal with other mineral types and, ultimately, with the rocks and soils that they comprise. An effort has been made to present this material in a form that is understandable to both geologists and nongeologists in the remote-sensing field. — Authors' abstract

Huntress, Wesley T., Jr. *See* Manatt, Stanley L. 06290

Hurley, P. M. *See* Bottino, M. L. 06128

06024 **Hustad, Paul Andrew.** Behavior of soils under impact loading [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 12, pt. 1, p. 5487B-5488B, 1970.

Ihochi, Haruhiko. *See* Kohman, Truman P. 06436

06324 **Illinois State Geological Survey.** Geological science field trip — Winchester area, Scott, Morgan and Greene Counties, Winchester and Griggsville quadrangles: Illinois Geol. Survey Guide Leaflet 1970B, 28 p., illus., tables, 1970.

In the Winchester area in western Illinois 3,500 feet of sedimentary rocks lie above the Precambrian basement. The uppermost 450 feet of Pennsylvanian and Mississippian formations are exposed. The Kansan and Illinoian glaciers covered the area in part. The Kansan drift is thin, patchy, and rarely exposed. The Illinoian drift overlies the bedrock and the Kansan drift and is extensively exposed. Thick outwash sand and gravel deposits occur in the Illinois Valley. Loess mantles the valley bluffs and the upland to the east, forming the surficial material of the area. Pennsylvanian cyclothems and the origin of the coals, a potential valuable resource, are described. Roadstone, agricultural lime, refractory brick and construction sand are produced. — EH

06325 **Illinois State Geological Survey.** Geological science field trip — Freeport area, Stephenson County, Freeport, Lena and Pecatonica quadrangles: Illinois Geol. Survey Guide Leaflet 1970C, 22 p., illus., tables, 1970.

In the Freeport area in northwestern Illinois, on the Precambrian granitic basement lie about 2,400 feet of sedimentary rocks ranging from Champlainian (Middle Ordovician) to Alexandrian (Early Silurian). The uplands are a drift mantle erosion surface developed on Ordovician dolomite. Tops of Silurian bedrock knobs about 1,100 feet high are remnants of a higher erosion surface. The Illinoian and Wisconsinan glaciers covered the area briefly leaving thin till and outwash deposits and filling the Pecatonica Valley with 100-200 feet of deposits. Peoria loess deposits of Wisconsinan age are a few feet thick and sediments from glacial Lake Silveria are about 15 feet thick along large valleys. Roadstone and agricultural lime are produced from near-surface dolomite formations and concrete aggregate and roadstone from outwash sand and gravel deposits. — EH

06326 **Illinois State Geological Survey.** Geological science field trip — Mt. Carroll area, Carroll County, Savanna and Mt. Carroll quadrangles: Illinois Geol. Survey Guide Leaflet 1969D and 1970D, 26 p., illus., table, 1970.

In the northwest part of the Mt. Carroll area in northwestern Illinois the bedrock surface in the "Driftless Area," by-passed by the glaciers, is eroded into sharp ridges and valleys. The upper 600 feet of 2,300 feet of Lower Paleozoic sedimentary rocks are exposed, chiefly dolomites of Champlainian (Middle Ordovician) and Alexandrian and Niagaran (Early to Middle Silurian) age. Toward the southeast the Illinoian glacier left a thin layer of drift which smoothed the topography to rounded hills. Loess,

the surficial material of the area, is 35 feet thick on the Mississippi bluffs and thins eastward from river valleys. Roadstone, sand and gravel are produced in the area. — EH

06327 **Illinois State Geological Survey.** Geological science field trip — Hamilton-Warsaw area, Hancock County, Keokuk 15-minute quadrangle: Illinois Geol. Survey Guide Leaflet 1970E and 1971B, 22 p., illus., tables, 1970.

Bedrock and glacial geology of the Hamilton-Warsaw area, Hancock County, in northwestern Illinois, and the geologic history of the Mississippi Valley are discussed. The area was covered by glaciers of the Nebraskan, Kansan and Illinoian Stages. The Mendon end moraine marks the maximum advance of the Illinoian glacier. An exposure of pre-Pleistocene(?) gravels is seen in an abandoned pit near Hamilton. A section shows the sequence from Paleozoic bedrock to the Peoria loess, deposited at the time of the Woodfordian glacier 22,000 to 12,000 years ago, which forms the surficial matter over much of Illinois. Geodes occurring in great numbers in the lower part of the Warsaw Shale are discussed. At a producing roadstone and agstone quarry, the Keokuk Limestone section is exposed. — EH

06454 **Illinois State Geological Survey.** Geological science field trip — Millstadt-Dupo area, St. Clair and Monroe Counties, French Village, Cahokia, Columbia and Millstadt 7.5-minute quadrangles: Illinois Geol. Survey Guide Leaflet 1970[A?], 33 p., illus., tables, 1970.

In the Millstadt-Dupo area of southwestern Illinois the broad, flat-bottomed Mississippi Valley contrasts with the deeply-dissected upland to the east. One thousand of the 4,000 feet of Paleozoic sedimentary rocks from Cambrian to Pennsylvanian in age which overlie the basement are exposed. Valmeyeran (middle Mississippian) limestone, Chesterian (Upper Mississippian) and Pennsylvanian formations comprise the surficial bedrock, the latter in the eastern part of the area. Kansan and Illinoian glaciers completely or partially covered the area. Kansas drift is absent, but Illinoian drift is exposed in many places on the upland. Thick outwash deposits occur in the Mississippi Valley. Loess thickly blankets the steep bluffs along the Mississippi River and the uplands, forming the surficial matter of the area. Some oil, coal, and crushed stone are produced. — EH

05875 **Inderbitzen, Anton L.** Marine geotechnique—What is it?: Oceanology Internat., v. 5, no. 12, p. 19-21, illus., 1970.

The author reviews developments in equipment and techniques for studying foundation properties of the sea floor. The U.S. Naval Civil Engineering Laboratory has devised three systems which measure shear strength, bearing capacity, and short-term settlement characteristics of sediments and the differential settlement of a footing in sediments. Other systems developed by various research groups include such instruments as nuclear or piezometric probes to measure bulk density of sediments or hydrostatic pressure in its pore spaces. Submersibles equipped with instrumentation show great promise. — EH

06219 **Ingamells, C. O.** Lithium metaborate flux in silicate analysis [with French and German abs.]: Anal. Chim. Acta, v. 52, no. 2, p. 323-334, 1970.

Lithium metaborate is an effective flux for silicates and other rock-forming minerals. The glass resulting from fusion is mechanically strong, reasonably nonhygroscopic, and is readily soluble in dilute acids. These characteristics lead to its use in X-ray spectrography and in methods which require whole-rock solutions, such as atomic absorption and emission spectrometry. Difficulties have been encountered in the use of such techniques; a high-quality reagent has been difficult to obtain; fusion conditions must be rather closely controlled; graphite crucibles used in the fusions need special treatment. Methods for overcoming these difficulties are outlined. Selected procedures for various instrumental methods of analysis are described. — Author's abstract

Ishikawa, Y. *See* Nagata, T. 06352

05847 **Iyer, H. M.** Seismology, *in* Global geophysics: New York, American Elsevier Publishing Company, p. 69-144, illus., tables, 1970.

Seismology is the study, measurement, and analysis of all movements of the solid Earth. These movements include all the most violent earthquakes to microseisms stimulated by violent storms at sea, and even those due to traffic on land, winds, or earthquakes simulated by nuclear bomb explosions. The following are discussed: types of seismic waves, instruments used to detect elastic waves, analysis of the Earth's structure from seismograms, quantitative seismology (determination of parameters of an earthquake), causes and distribution of earthquakes, and such miscellaneous topics as earthquake prediction, man-made earthquakes, crustal studies using explosions, earthquake engineering, normal mode oscillations of the Earth, microseisms, nuclear seismology, continental drift, ocean-floor spreading, and so forth. — VSN

00022 **Jack, Robert N.** The source of obsidian artifacts in northern Arizona: Plateau, v. 43, no. 3, p. 103-114, illus., tables, 1971.

Obsidians from nine extrusions in the San Francisco volcanic field of northern Arizona have been analyzed for 20 minor and trace elements and fall into five clearly defined trace-element groups; 217 artifacts (flakes and tools) from 16 sites in northern Arizona have also been analyzed by X-ray fluorescence, and the source of 186 of these has been identified. In the Flagstaff area the Government Mountain obsidian predominates as the raw material in all sites sampled. At least four different obsidian types from an unknown source have been found among samples from other sites in northern Arizona. — Author's abstract

05921 **Jackman, E. R.; Scharff, John.** Steens Mountain in Oregon's high desert country: Caldwell, Idaho, Caxton Printers, 203 p., illus., 1970.

Steens Mountain in the semidesert of southeastern Oregon is not part of any mountain range. In the four glacial periods during the last million years in North America, it was high enough so that snow accumulated upon it until the pull of gravity started a downhill flow of great masses of ice in all four directions; the glaciers started near the top, dug into the rock, and carved gigantic U-shaped valleys, each beginning abruptly in a semicircular wall where the ice started to move. Gorges, not subject to much erosion, are half a mile deep. This book consists of 18 chapters by the two authors on all phases of the area and its history. Of special interest are: horseback geology, erosion and change are normal, and the Steens Mountain gorges. — MCM

06133 **James, P. A.** The soils of the Rankin Inlet area, Keewatin, N.W.T., Canada: Arctic and Alpine Research, v. 2, no. 4, p. 293-302, illus., 1970.

Profiles representative of the soils of an area in the Canadian Arctic Barren Lands bordering Hudson Bay are described. The soils are classified according to the degree of disturbance by frost action and according to the state of soil drainage. Relatively undisturbed soils include those similar to Half Bog, Meadow Tundra, Upland Tundra, and Arctic Brown found elsewhere in the Arctic. Disruptions of soil horizons are associated with a number of periglacial processes. Evidence of podzolization in the well-drained soil comprises a slightly bleached horizon and, in one profile examined, an iron pan. The degree of podzolization is believed to be representative of the "low arctic" position of the area. No significant difference is apparent between soils which are 4,000 yr old and soils which are appreciably younger. — Author's abstract

06000 **Jamkhindikar, Suresh M.** Petrography and clay mineralogy of the Lawrence Shale Formation (Pennsylvanian) in Kansas [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 12, pt. 1, p. 5555B, 1970.

00005 **Janda, Richard J.** An evaluation of procedures used in computing chemical denudation rates: Geol. Soc. America Bull., v. 82, no. 1, p. 67-79, illus., tables, 1971.

Computations of rates of chemical denudation commonly are 1.4 to 2.4 times too large as 25-55 percent of weight of dissolved solids in streams draining silicate-rock terrane are from atmospheric and biospheric sources. Comparable, or slightly

smaller, non-rock contributions are assigned to water draining sedimentary rocks. Sources of error include: failure to recognize atmospheric-biospheric contributions especially of HCO_3^{-1}, Cl^{-1}, SO_4^{-2} and N species, sampling errors, and analytical uncertainties. Therefore sophisticated manipulation of published analytical data may be unwarranted. Pollution loads impose large, additional uncertainties. Identification of actual rock-derived components is difficult. Extrapolation of modern data to the geologic past is even more difficult. — JHF

06232 **Janke, N. C.** An empirical expression for the probability of particle passage through ideal screens — Discussion [of "Particle shape and influence of size from sieving," 1968]: Sedimentology, v. 14, nos. 3-4, p. 321-323, 1970.

Using a form factor, $E = T/[(L^2 + D^2 + T^2)/3]^{0.5}$, to represent particle shape, the dynamic sieve data of Ludwick and Henderson (ibid., v. 11, p. 197-235, 1968 [1969]; Abs. North American Geology, May 1970) can be presented as a single function, with a standard error of 4 percent. — Author's abstract

06186 **Jenkins, Lillie B.; Moore, Roosevelt.** Determination of lead in rocks and minerals after extraction with diethylammonium diethyldithiocarbamate, *in* Geological Survey research 1970, Chap. D: U.S. Geol. Survey Prof. Paper 700-D, p. D222-D224, table, 1970.

A method for determining low concentrations of lead in rocks and minerals is described. Samples are decomposed by attack with mixed acids followed by carbonate and sulfate fusions. Lead is extracted with diethylammonium diethyldithiocarbamate and determined by atomic absorption. Lead can be determined in the parts-per-million range with a standard deviation of 2 to 3 ppm. — Authors' abstract

06432 **Jennings, James R.** Preliminary report on fossil plants from the Chester Series (Upper Mississippian) of Illinois: Illinois Acad. Sci. Trans., v. 63, no. 2, p. 167-177, illus., 1970.

Numerous (33) localities at various geological horizons in the Chester Series of southern Illinois have yielded a diverse flora of vascular plants preserved as impressions, compressions including cuticle, and pyrite petrifactions. Included are: *Lepidodendron veltheimii, L. volkmannianum, L.* sp. with attached foliage; *Lepidostrobus; Lepidostrobophyllum; Stigmaria ficoides, S. stellata; Archaeocalamites* including attached foliage and cones; *Fryopsis; Rhodea; Sphenopteris; Sphenopteridium; Adiantites; Botryopteris*, cf. *Telangium; Rhynchogonium; Trigonocarpus*. This flora provides important floristic, morphological, and anatomical information about Upper Mississippian plants of North America. — *from* Author's abstract

Jepsen, H. F. *See* Henriksen, N. 06348

Johnson, G. L. *See* Schneider, E. D. 05795

Johnson, Gordon R. *See* Anderson, Lennart A. 06174

Johnson, Gordon R. *See* Anderson, Lennart A. 06175

05811 **Johnson, J. G.; Reso, Anthony; Stephens, Michael.** *Crurithyris subfissa*, new name for *Crurithyris fissa* Johnson, Reso, and Stephens, 1969: Jour. Paleontology, v. 44, no. 6, p. 1146, 1970.

The original name of the brachiopod species from the Upper Devonian West Range Limestone of Nevada is preoccupied by *C. fissa* George, 1931. — REG

Johnson, J. Harlan. *See* Horne, Gregory S. 05803

Johnson, J. M. *See* Robertson, J. A. 06419

05923 **Johnson, Philip L.** Remote sensing as an ecological tool [with French abs.], *in* Ecology of the subarctic regions (Ecologie des régions subarctiques) — Helsinki, Symposium, Proc.: Paris, UNESCO, p. 169-187, illus., tables, discussion, 1970.

Remote sensors may solicit information for: inventory and mapping of resources, quantifying the environment, describing flow of matter and energy, and evaluating changes in the ecosystem. In order to analyze the images, the fundamental matter and energy relations must be understood. The interpreter is also dependent on: his experience and training, the size, shape, and pattern of objects, and the tone or density variations in the films. In interior Alaska an extreme continental climate prevails, and the present vegetation mosaic is a mixture of forest, shrub, and herbaceous stands. Stability appears proportional to: stability of permafrost, elapsed time since last fire or flood, and age of the organic or mineral substrate. Selected examples of Alaskan subarctic vegetation are included to show the utility of aerial photography, radar, and thermal imagery. — *from* Author's abstract

Johnson, Stephen H. *See* Mooney, Harold M. 05876

06146 **Johnston, Paul M.; Pollock, Samuel J.; Weist, William G., Jr.** (compilers). Groundwater resources of the Potomac River basin, App. G *in* Potomac River basin report, V. 4: U.S. Cong., 91st, 2d sess., House Doc. 91-343, 114 p., paged separately, illus., tables, 1970.

As requested by the Corps of Engineers, this report (prepared in 1962) on a 16,000-sq-mi area west of Chesapeake Bay, includes description of the geologic formations and their water-bearing properties, and the occurrence, movement, quantity, and chemical quality of the ground water; analysis of ground-water conditions and availability in designated critical areas, especially in the Great Valley; and a plan for development of a supplemental ground-water supply for the Washington Metropolitan area. The nucleus of the plan is the outlining of a number of large well fields, each capable of yielding about 50 mgd, the individual well-field capacity specified. Where necessary to supplement existing information, special field studies were made, some detailed, others reconnaissance. Collected records of over 1,500 wells and about 170 springs are in open file (U.S. Geological Survey and Corps of Engineers), as are chemical analyses for about 240 water samples, and logs for about 170 wells. — GDC

Jones, J. M. *See* Runcorn, S. K. 06292

06140 **Jones, Thomas A.** Paleostructure and lithologic variation coefficients, their use in exploration for new oil and gas pools — Discussion [of paper by S. T. Ovnatanov and G. P. Tamrazyan, 1969]: Am. Assoc. Petroleum Geologists Bull., v. 54, no. 9, p. 1749-1750, 1970.

Well configurations on a hypothetical sandstone isopach map show that the coefficient of lithofacies change (L) and the coefficient of individual sandstone bed thickness variation (f), as defined by Ovnatanov and Tamrazyan (1969), is strongly influenced by the location of central points (wells). — SEF

05891 **Judd, John H.** Lake stratification caused by runoff from street deicing: Water Research, v. 4, no. 8, p. 521-532, illus., tables, 1970.

Salt is used for winter street deicing throughout most of the northern United States. Much of the salt is dissolved in the melt water and flows into surrounding surface water. Salt entering First Sister Lake, [Ann Arbor] Michigan increased the density of the water in the lower lake strata. During 2 of the 3 years studied, the increased density prevented complete spring overturn. This can be considered a temporary monomixis. The stability of stratification of the lake was computed. Stability was from 3.5 to 8.5 times greater than when no complete overturn occurred at other times. The lake mixed completely each fall. Laboratory and field tests indicate that salt left the lake and apparently entered the ground water of the area. Dichtothermic conditions were found in the lake. Density determinations indicated that this was an unstable condition, probably of short duration. — Author's abstract

06239 **Jung, Peter.** Fossil *Pleurotomaria* from Jamaica: Caribbean Jour. Sci., v. 10, nos. 1-2, p. 83-86, illus., 1970.

Both living and fossil representatives of the archaeogastropod genus *Pleurotomaria* are rare in the Caribbean region. As an addition to the Cenozoic fossil record of the genus in the West Indies (Jung, 1968), two specimens are here reported and figured. They were found in the Pleistocene Manchioneal Formation at two localities in eastern Jamaica. Both are identified as *P.* (*Entemnotrochus*) *adansoniana* Crosse and Fischer 1861, and seem to represent the first fossil record of the species. — VMJ

06363 **Kamb, Barclay.** Sliding motion of glaciers — Theory and observation: Rev. Geophysics and Space Physics, v. 8, no. 4, p. 673-728, illus., tables, 1970.

The sliding motion of glacier ice over bedrock is analyzed for arbitrary bedrock topography of low roughness. Fourier-analyzed topography is represented by a roughness spectral function defined in terms of mean square topographic amplitude. An approximate solution for actual nonlinear rheology is built, assuming that the second strain-rate invariant depends only on distance from ice-bedrock contact. Transition wavelength between regelation and plastic flow, constant in linear theory, is replaced in nonlinear theory by a velocity- and roughness-dependent parameter. Studies are given for three types of roughness spectral function — white roughness, truncated white roughness, single wavelength — and for cross-corrugated sinusoidal waves. Results are tested against field observations of sliding, and imply a relatively high sensitivity of sliding velocity to changes in glacier thickness or surface slope. — *from* Author's abstract

Kanamori, Hiroo. *See* Horai, Ki-iti. 06285

06288 **Kanamori, Hiroo; Amos, Nur; Chung, D. H.; Simmons, Gene.** Elastic wave velocities of lunar samples at high pressures and their geophysical implications, *in* Apollo 11 Lunar Sci. Conf., Houston, Tex., 1970, Proc. — V. 3, Physical properties: New York, and Oxford, England, Pergamon Press (Geochim. et Cosmochim. Acta Supp. 1), p. 2289-2293, illus., tables, 1970.

Ultrasonic measurement of *P* and *S* velocities of Apollo 11 lunar samples 10020, 10057 and 10065 to 5 kbar pressure at room temperature shows a pronounced increase of velocity (as much as twofold) for the first 2 kbar. The traveltimes predicted from the velocity-depth curve of sample 10057 are consistent with the results of the Apollo 12 seismic experiments. At pressures below 200 bar, the samples are highly attenuating; for both *P* and *S* waves, the value of *Q* is about 10. — Authors' abstract

Kanasewich, Ernest R. *See* Montalbetti, James F. 05842

Kaplan, I. R. *See* Brown, Frederick S. 06073

Kardos, J. L. *See* Hoyt, H. P., Jr. 06287

05954 **Katz, Samuel.** Memorial of Joseph Leon Rosenholtz: Am. Mineralogist, v. 55, nos. 3-4, p. 595-596, portrait, 1970.

Kaufman, Aaron. *See* Broecker, Wallace S. 06404

Kaufman, Aaron. *See* Broecker, Wallace. 06405

06445 **Kay, Marshall.** Flysch and bouldery mudstone in northeast Newfoundland [with French abs.], *in* Flysch sedimentology in North America: Geol. Assoc. Canada Spec. Paper 7, p. 155-164, illus., 1970.

[On islands of Notre Dame Bay] lower Paleozoic rocks contain "normal" flysch, interbedded siltstone, and greywacke with typical sedimentary structures. Silurian conglomerates, with well rounded igneous and sedimentary boulders, ill-sorted, and interbedded with sole-marked greywacke and shale, coarsen in northern sequences, with shallow marine faunas. The Dunnage Formation, a mudstone mélange with blocks of greywacke, pillow lava, agglomerate, and dolomite in a matrix of argillite

and greywacke, includes serpentinized mafic rocks and xenoliths of serpentine in intermediate intrusives. In a fault bounded belt several km wide, the Dunnage may have been a gravity slide into a trench, in a subduction zone where an oceanic plate moved beneath an Alpine-type continental margin. It is not demonstrably an allochthon carried over a continental tectonic terrane. — *from* Author's abstract

05886 **Kazmann, Raphael G.** The present and future ground-water supply of the Baton Rouge area: Louisiana Water Resources Research Inst. Bull. 5, p. 1-44, illus., tables, 1970.

The "600-ft sand," a principal Baton Rouge aquifer, has become degraded by saline water drawn east- and then northward by heavy industrial pumping from a trapped source west of the offtake area. Because this water moves through a geological constriction formed by the Baton Rouge fault to the south and a clay plug north of the fault, its flow is limited. Further westward movement can be halted by pumping it to waste from properly-located wells; later, injection of fresh water from a shallower aquifer could form a pressure barrier against eastward flow. Maximum land subsidence resulting from continued drawdowns in the 10 presently-used aquifers may reach five feet. Fresh water (100-150 mgd) imported from the Amite River is proposed as the future water supply; for peak-demand storage, part of it could be injected into several aquifers. — *from* Author's abstract

Keeney, Dennis R. *See* Konrad, John G. 06373

00015 **Keller, Edward A.** Pools, riffles, and meanders — Discussion [of paper by K. J. Tinkler, 1970]: Geol. Soc. America Bull., v. 82, no. 1, p. 279-280, illus., 1971.

The paper under discussion was published in ibid., v. 81, no. 2, p. 547-552, 1970; Abs. North American Geology, July 1970.

Keller, F. J. *See* Wark, J. W. 06147

05852 **Kelling, Gilbert; Stanley, Daniel J.** Morphology and structure of Wilmington and Baltimore submarine canyons, eastern United States: Jour. Geology, v. 78, no. 6, p. 637-660, illus., tables, 1970.

On the basis of bathymetric, seismic, sediment, and other studies, the salient features and history of these canyons are inferred to be similar. Both canyons trend generally southeast across the continental slope and rise, and both have upper "hooks" — south-trending segments cut into the shelf. This segmented form is interpreted to result from two-stage development: the southeast-trending segments (and buried channels on the shelf that appear to align with them) originated during a late Teritary episode of low sea level; the south-trending segments formed later during Pleistocene lowstands. Wilmington canyon is said to be steeper, more incised, traceable over a greater distance, and still active. Baltimore canyon is more mature and presently inactive. In this vicinity, large slumped masses occur on both the continental slope and the upper part of the rise. — DRM

Kelling, Gilbert. *See* Stanley, Daniel J. 06129

05981 **Kentucky Geological Survey.** Bibliography of coal in Kentucky: Kentucky Geol. Survey, Ser. 10, Spec. Pub. 19, 73 p., 1970.

Included with the bibliography are a subject index and a county index.

Kepferle, Roy C. *See* Peterson, Warren L. 06167

05940 **Kerr, I. S.; Gard, J. A.; Barrer, R. M.; Galabova, Iliana M.** Crystallographic aspects of the co-crystallization of zeolite L, offretite and erionite: Am. Mineralogist, v. 55, nos. 3-4, p. 441-454, illus., tables, 1970.

An investigation has been made of zeolite crystallizates in which one or more of offretite, erionite and zeolite L are present. Contrary to previous observations X-ray

powder patterns can differentiate between offretite and erionite. Where amounts of either crystal are small electron diffraction by single crystallites distinguishes between the species. The offretite and erionite crystals were thereby shown to be faulted in planes normal to the *c*-axis. In characteristic hammer-shaped crystals the shaft tended to be of faulted offretite and the head consisted of zeolite L, from which the offretite in the shaft appeared to have grown epitaxially. Zeolite L has a predominant flaky habit, whilst offretite and erionite grow as rod-like crystals. The marked tendency to co-crystallization of L, offretite and erionite appears to be related to the common elements in their aluminosilicate frameworks. — Authors' abstract

05794 **Kerr, Paul F.; Drew, Isabella M.; Richardson, Darlene S.** Mud volcano clay, Trinidad, West Indies: Am. Assoc. Petroleum Geologists Bull., v. 54, no. 11, p. 2104-2110, illus., tables, 1970.

Mud volcanoes often have appeared suddenly along an east-west trend of anticlinal uplifts on and off the south shore of Trinidad. Montmorillonite is the predominant clay mineral. Mud volcano clay is thixotropic, in that the wet clay changes suddenly from an undisturbed mass to a flowing fluid with strong rafting power. Where these mobile masses of impervious material accumulate along partly broken anticlinal structures upward impelling forces, generated by gas pressure and/or tectonic squeezes, may cause diapiric intrusions. — BHK

Ketner, Keith B. *See* Smith, George I. 06162

06163 **Ketner, Keith B.** Limestone turbidite of Kinderhook age and its tectonic significance, Elko County, Nevada, *in* Geological Survey research 1970, Chap. D: U.S. Geol. Survey Prof. Paper 700-D, p. D18-D22, illus., 1970.

A limestone unit of Kinderhook (early Early Mississippian) age is exposed in the Swales Mountain quadrangle, southern Independence Range, Nev. This unit, here termed the Camp Creek sequence, is underlain concordantly by the Roberts Mountains Formation and is overlain by thrust plates composed of Ordovician and Devonian rocks. Sedimentary features of the Camp Creek indicate that it was deposited by turbidity currents which flowed from the miogeosyncline toward the eugeosyncline. All thrust faults in the area are younger than the Camp Creek sequence and, therefore, younger than the Roberts Mountains thrust as dated in the neighboring Piñon Range. — Author's abstract

06460 **Khanna, Sat Dev.** Experimental investigation of form of bed-roughness: Am. Soc. Civil Engineers Proc., v. 96, paper 7623, Jour. Hydraulics Div., no. HY 10, p. 2029-2040, illus., 1970.

Experimental observations regarding mean velocity distribution, angle of flow, static pressure distribution and longitudinal turbulence intensity are all made along a typical wooden wave in the domain of ripples and dunes of river flow. The wave was produced in a low-turbulence wind tunnel and measurements were made by hot-wire anemometry in an air medium. From these observations skin friction coefficient, form drag, and other boundary layer parameters have been evaluated to help analyze the process of sediment transport. — ASCE abstract

Kimmel, G. E. *See* Cohen, Philip. 06191

06440 **King, Darrell L.** The role of carbon in eutrophication [with French, German, Portuguese, and Spanish abs.]: Water Pollution Control Federation Jour., v. 42, no. 12, p. 2035-2051, illus., tables, 1970.

Interactions between algal communities and the carbonate alkalinity system are of great importance in eutrophic waters. The availability of a photosynthetic carbon dioxide source for algal photosynthesis is a significant determining factor in the eutrophic process. The amount of carbon dioxide available, as mediated by the alkalinity of a water, determines both the amount of algal production and the type of algae present. Blue-green algae have the ability to continue photosynthetic activity to lower carbon dioxide concentrations than other algae, which allows them to dominate under eutrophic conditions. — Author's abstract

05868 **King, Lewis H.; MacLean, Brian.** Continuous seismic-reflection study of Orpheus gravity anomaly: Am. Assoc. Petroleum Geologists Bull., v. 54, no. 11, p. 2007-2031, illus., 1970.

Continuous seismic-reflection profiles across the Scotian shelf south of Cape Breton Island, Nova Scotia, reveal the presence of moderately folded Cretaceous rocks within the area represented by the Orpheus negative gravity anomaly. The folded strata are confined to the anomalous area, and contrast with the gently seaward-dipping strata typical of most other parts of the shelf. Bedrock units are recognized on the continuous seismic-reflection records by unconformable relations and differences in definition, nature and frequency of seismic events depicting layered sequences. A preliminary geologic map was constructed from these data, the adjacent land geology, and the gravity, magnetic, and seismic-reflection data obtained by other workers. Rocks in the anomaly area are thought to range in age from pre-Pennsylvanian to probable Tertiary. — *from* Authors' abstract

06027 **King, Philip B.** The Precambrian of the United States of America — Southeastern United States, *in* The geologic systems — The Precambrian, V. 4 (Kalervo Rankama, editor): New York and London, Interscience-John Wiley and Sons, p. 1-71, illus., tables, 1970.

Precambrian rocks of the southeastern U.S. are described in geographic order from the continental interior or foreland of the Appalachian Mountain System to its backland near the Atlantic Coast. Although they are an important element in the Appalachian Mts., the surface extent of these rocks is less than shown on published maps, particularly in the Piedmont where some rocks assigned to Precambrian are actually younger. The sequence may be divided into two units both of which are best exposed in the Blue Ridge province. In the older unit a few maximum radiometric ages of 1,000 m.y. (Grenville orogeny) or more and many apparent ages down to 350 m.y. or less have been determined. This unit is separated from overlying Paleozoic or younger Precambrian units by the greatest unconformity below the top of the Paleozoic. The younger unit (precise age unknown) is not found in drill holes northwest of the Appalachian region; its only extensive counterpart is in the Cordilleran region of North America. — VSN

Kinoshita, H. *See* Nagata, T. 06352

05994 **Klimowski, Richard Joseph.** Development and application of a high-resolution mass spectrometer-computer system [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 12, pt. 1, p. 5461B, 1970.

Kline, D. *See* Weeks, R. A. 06300

05791 **Klusman, Ronald W.** A comprehensive computer program for plotting of electron microprobe elemental profiles: Jour. Geology, v. 78, no. 6, p. 751, 1970.

A FORTRAN IV program plots electron microprobe elemental profiles in linear or semilogarithmic modes. The program allows plotting of multiple sets of data in a wide variety of modes. — *from* Author's abstract

05841 **Koch, Neil C.** Geology and water resources of Campbell County, South Dakota — Pt. 2, Water resources: South Dakota Geol. Survey Bull. 20, pt. 2, 38 p., illus., tables, 1970.

Campbell County is nearly covered by Pleistocene glacial drift and lake deposits and Holocene alluvium and colluvium, ranging from a thin veneer to more than 475 feet and overlying Cretaceous Pierre Shale and Fox Hills Formation. A deep-glacial aquifer averages about 70 feet in thickness, underlies about 20 percent of the county, contains about 2.5 million acre-feet of water in transient storage, and supplies about 11 percent of water used. Shallow-glacial aquifers cover 40 percent of the county and yield as much as 500 gpm to wells. Both aquifer waters, suitable for irrigation under certain soil conditions, are high in bicarbonate and sulfate. The artesian Dakota and Fall River aquifers, underlying all of the county at a depth of about 2,000 feet, furnish water of sufficient quantity for domestic and farm needs. — *from* Author's abstract

06436 **Kohman, Truman P.; Black, Lance P.; Ihochi, Haruhiko; Huey, James M.** Lead and thallium isotopes in Mare Tranquillitatis surface material, *in* Apollo 11 Lunar Sci. Conf., Houston, Tex., 1970, Proc. — V. 2, Chemical and isotope analysis: New York, and Oxford, England, Pergamon Press (Geochim. et Cosmochim. Acta Supp. 1), p. 1345-1350, illus., table, 1970.

Lead from Apollo 11 fines is more radiogenic than any meteoritic lead reported and older than any terrestrial radiogenic lead: Pb-204:Pb-206:Pb-207:Pb-208 = 1:99:69:117. Comparison with primordial lead from meteoritic troilite yields a Pb-207:Pb-206 age of $4.7 \pm 0.1 \times 10^9$ yr. The U-238:pb-204 ratio is > 90 and the Th-232:U-238 ratio is 3.9 ± 0.1. The lead content is $> 1.7 \times 10^{-6}$. Evidently Pb was strongly depleted and Th and U strongly enriched in the formation of this material. Thallium was too low ($< 5 \times 10^{-9}$) to yield mass spectra, but indications are favorable for eventual observation of extinct natural radioactivity of Pb-205. — *from* Authors' abstract

05857 **Kohnen, Heinz.** Über die Absorption elastischer longitudinaler Wellen im Eis [The absorption of elastic longitudinal waves by ice (with English abs.)]: Polarforschung 1969, v. 39, pt. 6, no. 1, p. 269-275, illus., 1970.

During the Second International Glaciological Greenland Expedition 1967, extensive seismic refraction work was carried out. The first arrivals of direct P-waves were used to compute the frequency spectra, and the amplitudes for the attenuation constants. Within the narrow frequency range of 50-100 cycles per second, it is not certain whether there is a first- or second-power relation between the attenuation constant and the frequency. From the comparison of attenuation measurements in the range from 10-30 kc, a linear relation is assumed. — *from* Author's abstract

Kolopus, J. L. *See* Weeks, R. A. 06300

Kono, M. *See* Nagata, T. 06352

06373 **Konrad, John G.; Keeney, Dennis R.; Chesters, Gordon; Chen, Kuan-Lin.** Nitrogen and carbon distribution in sediment cores of selected Wisconsin lakes [with French, German, Portuguese, and Spanish abs.]: Water Pollution Control Federation Jour., v. 42, no. 12, p. 2094-2101, tables, 1970.

Nitrogen and carbon distribution analyses were conducted of sediment profiles from two southern Wisconsin hard-water and two northeastern Wisconsin soft-water lakes. Little effect of cultural eutrophication was evident in the total nitrogen and organic carbon data except for Lake Mendota where nitrogen and carbon contents on a carbonate-free basis increased markedly in the marl layer. In all profiles exchangeable and soluble ammonium-nitrogen values were high, and in most cases they increased with depth in the profile. Nitrate-nitrogen contents of the interstitial waters increased with depth for the hard-water lake sediments; in the soft-water lake sediments nitrate-nitrogen contents were relatively constant. Total and available nitrogen values were high throughout the profiles. — Authors' abstract

Korringa, Marjorie K. *See* Noble, Donald C. 06164

05907 **Kottlowski, Frank E.** Paleozoic geologic history of southwest New Mexico and northwest Chihuahua [summ.], *in* The geologic framework of the Chihuahua tectonic belt — Symposium in honor of Ronald K. De Ford, Midland, Tex., 1970: Midland, Tex., West Texas Geol. Soc., p. 16-18, 1970.

06222 **Krinitzsky, E. L.; Rader, Miles.** Attrition among geologists: Geotimes, v. 15, no. 10, p. 24-26, 1970.

A questionnaire sent out to 2,000 dropout geologists by the Committee on Professional Employment Standards of the American Institute of Professional Geologists, resulted in 459 replies. A majority left geology before they were 35 years old, and are earning more now than they did then. Petroleum geology accounts for two-thirds of the dropouts. Dissatisfaction seemed to be the main reason for leaving, although terminations and early retirement are significant. Almost a third would like to return to

geology as a profession. Over half believed that a professional society could have helped in problems of geological employment. — ESL

Kriz, George J. *See* Rochester, Eugene W., Jr. 05785

06311 **Krumbein, William C.** Mathematical geologists: Geotimes, v. 17, no. 8, p. 16, 1970.

The International Association for Mathematical Geology, founded in 1968, holds general sessions during the International Geological Congresses, and regular sessions during meetings of the International Statistical Institute. In addition the IAMG sponsors meetings with other groups on computer applications and quantitative geology. At the 1970 Council Meeting it was decided to publish a newsletter twice a year. Publication policies of the Journal of the IAMG are reviewed. Officers and council members are announced. — ESL

Ku, Teh-Lung. *See* Broecker, Wallace. 06405

05982 **Kullmann, Jürgen; Scheuch, Jörn.** Wachstumms-Änderungen in der Ontogenese paläozoischer Ammonoideen [Proportional growth changes during the ontogenies of Paleozoic ammonoids (with English abs.)]: Lethaia, v. 3, no. 4, p. 397-412, illus., 1970.

Ontogenetic allometries of about 50 Carboniferous goniatite species from Germany, Spain, and U.S., studied by geometrical measurements of shell cross sections, indicate changes of proportions during ontogeny between coiling spiral, umbilical spiral, and whorl width. The allometry constants change suddenly at defined stages; thus each phase of ontogenetic growth pattern is determined by a different allometric formula. American specimens were studied and illustrated in cross section by Gordon (1965) in "Carboniferous cephalopods of Arkansas." Graphs showing allometric growth patterns during ontogenies of five species are illustrated as examples; the four American species are: *Eumorphoceras bisulcatum*, *Girtyoceras meslerianum*, both from Caney Shale, Okla.; *Schartymites ozarkensis*, Fayetteville Shale, Ark., and the closely related *S. barnettensis*, Barnett Formation, Tex. — VMJ

06112 **Kumarapeli, P. S.** Monteregian alkalic magmatism and the St. Lawrence rift system in space and time, *in* Alkaline rocks, the Monteregian Hills — Symposium, Montreal, 1969, Proc.: Canadian Mineralogist, v. 10, pt. 3, p. 421-431, illus., 1970.

Monteregian igneous bodies are largely concentrated in an approximately east-southeast trending zone that extends across the southern part of St. Lawrence valley, which is essentially a graben, forming part of the St. Lawrence rift system. The Beauharnois axis that marks the south end of the St. Lawrence valley is a transverse "arch", which may have formed as a direct result of structural subsidence along the valley. On the north flank of the Beauharnois axis are a number of normal faults along which the axis has apparently undergone relative uplift. Intersections of these faults with meridional faults of the graben structure may have produced openings for ascent of Monteregian magmas. Monteregian alkalic magmatism is probably synchronous with the latest phase of major tectonic movements along the St. Lawrence rift system. — *from* Author's abstract

06001 **Kunzler, Robert Henry.** The aragonite-calcite transformation [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 12, pt. 1, p. 5555B-5556B, 1970.

Labotka, Theodore C. *See* Hester, Norman C. 05854

Lamb, W. *See* Geake, J. E. 06277

06226 **LaMoreaux, Philip E.; Simpson, Thomas A.** Birmingham's Red Mountain cut: Geotimes, v. 17, no. 8, p. 10-11, illus., 1970.

A roadcut on the Red Mountain Expressway near Birmingham, Ala., exposes a section from the Ordovician Chickamauga Limestone to the Mississippian Floyd Shale.

Structural features associated with Appalachian mountain building can be observed also. Birmingham, the largest mining camp in the world, was started because iron ore, coal, and limestone for smelting all occur within 20 to 30 miles. Vast reserves of hematite ore remain in the Big Seam and will be mined again in the future. — ESL

Land, Lynton S. *See* Behrens, E. William. 06057

06234 **Land, Lynton S.** Phreatic versus vadose meteoric diagenesis of limestones — Evidence from a fossil water table: Sedimentology, v. 14, nos. 3-4, p. 175-185, illus., tables, 1970.

The Middle Pleistocene Belmont Formation of Bermuda consists in part of beach-dune biocalcarenites which underwent intense contemporaneous cementation and diagenesis. The beach deposits were contemporaneously cemented by fibrous isophacous cement to form beachrock, whereas previously deposited eolianites further inland underwent intense meteoric phreatic diagenesis, resulting in coarse-grained cementation and stabilization of most of the metastable components of the rock. Above the Belmont water table, vadose diagenesis was relatively ineffective in cementing and altering the biocalcarenites. Phreatic meteoric diagenesis is interpreted to be a very rapid process, relative to vadose meteoric diagenesis, and to result in a much coarser-grained sparite. — Author's summary

06235 **Land, Lynton S.; Epstein, S.** Late Pleistocene diagenesis and dolomitization, North Jamaica: Sedimentology, v. 14, nos. 3-4, p. 187-200, illus., tables, 1970.

Diagenesis, including dolomitization, of Late Pleistocene reefs of North Jamaica is due to reaction with meteoric water. Although the reactions: Mg-calcite to calcite, aragonite to calcite, Mg-calcite to dolomite, retain microarchitectural information, complete chemical redistribution takes place so that incongruently dissolved Mg-calcites, aragonite inversion mosaics (neomorphosed aragonite), and dolomitized red algae have similar isotopic compositions, resembling precipitated calcite cements. The minerals all appear to have stabilized in the meteoric water environment. The dolomite is not widely distributed, and is restricted to replacement of red algae. There has been no net addition of magnesium to the red algal clasts. — Authors' summary

LaPray, Reed. *See* Arnow, Ted. 06188

06353 **Larochelle, A.; Schwarz, E. J.** Magnetic properties of lunar sample 10048-22, *in* Apollo 11 Lunar Sci. Conf., Houston, Tex., 1970, Proc. — V. 3, Physical properties: New York, and Oxford, England, Pergamon Press (Geochim. et Cosmochim. Acta Supp. 1), p. 2305-2308, illus., reprinted 1970.

The natural remanent magnetization (3.7×10^{-4} e.m.u./cm^3) and the susceptibility per cubic centimeter (6.3×10^{-3}) of an 18.5-g breccia specimen were determined with instrumentation and techniques currently used in paleomagnetism. The relatively low magnetic stability of the rock in the Earth's field and in alternating demagnetizing fields precludes considering it as a reliable carrier of paleomagnetism. A magnetic balance study yields an unusually high Curie temperature (750°C) which is possibly diagnostic of metallic Fe containing less than 5 per cent nickel. The estimated relative abundance of the iron in the sample is about 0.5 percent. [*reprinted from* Science, v. 167, p. 700-701, 1970.] — Authors' abstract

06251 **Larsen, Leo.** The International Hydrological Decade Programme in Narssaq river valley, south Greenland, *in* Report of activities, 1969: Grönlands Geol. Undersögelse Rap. 28, p. 35-36, 1970.

Mapping of ground water in sediments of the Narssaq river valley has revealed that area rocks are mostly impermeable, but in the valley bottom a system of Quaternary deposits serve as reservoirs. On both sides of the river, three generations of alluvial terraces range from sea level in the west to an altitude of 100 m in the east, where tributaries limit the area. Steep walls of Narssaq Fjeld to north and Qáqárssuaq to south limit the ground-water system, an area of 3 sq km. Grain size of the material is

mainly in sand-gravel fractions. From water-level measurements in five dug wells and several springs, a water table contour map was constructed; fluctuations in three wells correlated closely with variations in rainfall. To get an exact value of porosity, samples of sediments measured for permeabilities by pumping tests and tracers are being examined in the laboratory. — GDC

Larson, E. E. *See* Strangway, D. W. 06297

Lasca, Norman P. *See* Nelson, Katherine G. 06225

06257 **Latham, Gary V.** (and others). Seismic data from man-made impacts on the Moon: Science, v. 170, no. 3958, p. 620-626, illus., tables, 1970.

Unusually long reverberations were recorded from two lunar impacts by a seismic station installed on the lunar surface by the Apollo 12 astronauts. Data suggest that the lunar mare at the Apollo 12 landing site consists of material with very low seismic velocities near the surface, increasing to 5 to 6 kmps for compressional waves at a depth of 20 km. Absorption of seismic waves is extremely low relative to typical continental crust on Earth. It is unlikely that a major boundary similar to the crust-mantle interface on Earth exists in the outer 20 km of the Moon. Dispersion and scattering of surface waves probably explains the lunar seismic reverberation. Scattering implies heterogeneity within the outer zone of the mare on a scale of several hundred m (or less) to several km. Seismic signals from 160 events of natural origin have been recorded during the first 7 months; at least 26 are small moonquakes, and many are thought to be meteoroid impacts. — *from* Authors' abstract

06289 **Latham, Gary V.** (and others). Apollo 11 passive seismic experiment, *in* Apollo 11 Lunar Sci. Conf., Houston, Tex., 1970, Proc. — V. 3, Physical properties: New York, and Oxford, England, Pergamon Press (Geochim. et Cosmochim. Acta Supp. 1), p. 2309-2320, illus., 1970.

Seismometer operation for 21 days at Tranquillity Base revealed, among strong signals produced by the lunar module (LM) descent stage, a small proportion of probable seismic signals. The latter are long-duration, complex, emergent oscillations which lack the discrete phases of earthquake signals. By similarity with the impact signal of the Apollo 12 ascent stage, they are thought to be produced by meteoroid impacts or shallow moonquakes. This signal character may imply transmission with very high Q and intense wave scattering, conditions which are mutually exclusive on Earth. Natural background noise is very much smaller than on Earth, and lunar tectonism may be very low. — Authors' abstract

05944 **Laughon, R. B.** New data on guildite: Am. Mineralogist, v. 55, nos. 3-4, p. 502-511, illus., tables, 1970.

Guildite is monoclinic with $a = 9.786$, $b = 7.134$, $c = 7.263$ and $\beta = 105°17'$. Systematic extinctions show the space group to be $P2_1/m$ or $P2_1$. Available evidence points to a probable formula of $2[CuFe(SO_4)_2(OH)4H_2O]$. — Author's abstract

Laughton, A. S. *See* Berggren, W. A. 06160

Law, A. D. *See* Burns, Roger G. 06082

Leaird, James D. *See* Burkett, David H. 06081

LeBlanc, Rufus J. *See* Bernard, Hugh A. 05898

LeBlanc, Rufus J., Sr. *See* Bernard, Hugh A. 05896

06022 **Lee, Chun Chi.** The decomposition of organic matter in some shallow water, calcareous sediments of Little Black Water Sound, Florida Bay [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 12, pt. 1, p. 5582B, 1970.

06183 **Lee, Donald E.; VanLoenen, Richard E.** Biotites from hybrid granitoid rocks of the southern Snake Range, Nevada, *in* Geological Survey research 1970, Chap. D: U.S. Geol. Survey Prof. Paper 700-D, p. D196-D206, illus., tables, 1970.

Biotite compositions indicate distinctly different magmatic affinities for two adjacent masses of hybrid granitoid rocks. Within one, assimilation of host rocks as chemically distinct as limestone and quartzite has produced a commensurate range of biotite compositions. The trend suggests that oxygen fugacities in contaminated magma during biotite crystallization were slightly higher than those defined by the Ni-NiO buffer. The magma was 'buffered' with respect to oxygen by magnetite that coexists with each biotite analyzed. Within the second mass, assimilation of argillite produced a granitoid rock devoid of iron oxide minerals, in which biotite coexists with large amounts of muscovite. The uniformly low MgO content of biotites suggests initial equilibration with respect to the same relatively low oxygen fugacity; sharply defined Fe_2O_3/FeO values are due to postmagmatic processes. — *from* Authors' abstract

06209 **Lee, Donald E.; Marvin, Richard F.; Stern, T. W.; Peterman, Zell E.** Modification of potassium-argon ages by Tertiary thrusting in the Snake Range, White Pine County, Nevada, *in* Geological Survey research 1970, Chap. D: U.S. Geol. Survey Prof. Paper 700-D, p. D92-D102, illus., tables, 1970.

U-Th-Pb isotopic dating of granitoid rocks exposed over about 20 sq mi within Wheeler Peak and Garrison quadrangles, Nevada, have shown the main intrusive to be Middle Jurassic; an Oligocene aplite phase is recognized in the southern Snake Range. However, K-Ar ages from the Jurassic terrane range from 17.0 to 156 m.y., and ages on micas from Precambrian and Cambrian metasediments range from 22.1 to 259 m.y. Generally, K-Ar ages of mica increase with distance below the Snake River décollement, and the Tertiary-Cretaceous age range is interpreted as a reflection of argon loss due to thermal stresses during Tertiary activity along the thrust fault which deformed part of the Middle Jurassic intrusive. Thus, activity along the Snake Range décollement about 17-18 m.y. ago (Miocene) is indicated.—VSN

06020 **Lee, Keenan.** Infrared exploration for shoreline springs, a contribution to the hydrogeology of Mono Basin, California [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 12, pt. 1, p. 5577B, 1970.

05899 **Leon Vallejo, G.; Segalen, P.** Observations sur des sols rouges dérivés de roches volcaniques basiques dans le Bajio (Mexique Central) [Observations on some red soils derived from basic volcanic rocks in the Bajio (Central Mexico) (with English and Spanish abs.)]: [France] Office Recherche Sci. et Tech. Outre-Mer Cahiers, Ser. Pedologie, v. 8, no. 1, p. 49-60, illus., tables, 1970.

Red soils derived from basalt were observed in Mexico between the capital and Guadalajara. Morphological, chemical, and mineralogical features were studied. The soils were compared with those derived from similar parent materials in similar situations and with others developed in more humid or drier climates. It is proposed that these soils be classified as typical, weakly-desaturated ferrallitic soils. — *from* Authors' abstract

06265 **Levinson, A. A.** (editor). Proceedings of the Apollo 11 lunar science conference, Houston, Tex., 1970 — V. 3, Physical properties: New York, and Oxford, England, Pergamon Press (Geochim. et Cosmochim. Acta Supp. 1), p. 1937-2492, illus., tables, 1970.

At the Apollo 11 Lunar Science Conference, held in Houston on January 5-8, 1970, 150 principal investigators reported the results of an intensive three-month study of Apollo 11 samples. This volume comprises an essentially complete record of the first investigations of the physical properties of those samples. The data and interpretations presented by the various authors represent the state of knowledge as of late February 1970. — DBV

05946 **Levitt, S. R.; Condrate, R. A., Sr.** The preparation of fine mineral powders for infrared spectroscopy: Am. Mineralogist, v. 55, nos. 3-4, p. 522-524, illus., 1970.

A new technique for preparing fine mineral powders for infrared studies is described here. Fine powders can be prepared by self-grinding the crystals in a test tube containing acetone. Both the Christiansen effect and the effect of prolonged grinding with a mortar and pestle are eliminated from the spectra. The powder infrared spectrum of pyromorphite is used to illustrate the spectra obtained with powders ground by various procedures. — Authors' abstract

06338 **Levy, Harold H.** Earth-resources technology satellite — NASA Data-Processing Facility: IEEE Trans. Geosci. Electronics, v. GE-8, no. 4, p. 348-352, illus., table, 1970.

The earth-resources technology satellite (ERTS) NASA Data-Processing Facility (NDPF) is organized into two units: the telemetry and image data processing where the bulk of all data are transformed into user-oriented media; and the data services laboratory where all production scheduling, accounting, cataloguing, storage and retrieval, dissemination, and user services will be performed. The NDPF will be a facility for doing only ERTS processing and will be colocated with the Operations Control Center in Building 23 of Goddard Space Flight Center. The facility is planned to be capable of processing a data volume based on continental U.S. coverage plus 1 hour per day of video data obtained from an on-board wide-band video tape recorder. — *from* Author's abstract

Lewin, S. Z. *See* Baer, N. S. 05942

05874 **Lewis, Anthony J.; MacDonald, Harold C.** Interpretive and mosaicking problems of SLAR imagery: Remote Sensing Environment, v. 1, no. 4, p. 231-236, illus., table, 1970.

Side-looking airborne radars (SLAR) use either a slant range or a ground range imagery presentation. Because slant range imagery lacks geometric proportionality, mosaic preparation is difficult. Although ground range imagery would greatly simplify the construction of a radar mosaic, interpretive data loss caused by radar layover in mountainous areas would be more prevalent than with a slant range display. Analysis of terrain geometry, radar shadow, and radar layover provides evidence that a dual mode of image recording will be necessary for optimum geoscience interpretation and simplification of mosaicking. — Authors' abstract

05885 **Lewis, James E.** Water-resources manpower — Supply and demand patterns to 1980: Louisiana Water Resources Research Inst. Bull. 4, 48 p., illus., tables, 1970.

The supply of scientific manpower is related to educational potential of the general population and productive capacity of the educational system. Independent projections of scientific manpower and demand are disaggregated to yield supply and demand projections for water-resources manpower, a supply projected at 3.3 million for 1980, the demand at 3.5 million. Supply and demand relations for 1970-80 show a 10-percent deficit of engineers, a 5-percent surplus of natural scientists, and a 7-8 percent deficit of social scientists. The supply of water-resources manpower is projected to reach 154,000 by 1980, with about 55,000 persons engaged in research; the 1980 demand is projected at 267,000 with 95,000 in research. Critical manpower shortages are forecast in: ecology, hydrology, water-resources planning and management, water quality, and watershed management. — *from* Author's abstract

06002 **Lewis, John Richard.** Structure and stratigraphy of the Rossie complex, northwest Adirondacks, New York [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 12, pt. 1, p. 5556B, 1970.

Liang, S. S. *See* Asunmaa, S. K. 06268

Liao, Cheng-Sun. *See* Huang, Ju-Chang. 05871

06349 **Likussar, W.; Sparks, G. E.; Boltz, D. F.** The ultraviolet spectrophotometric determination of rhenium by the pyrrolidinedithiocarbamate method [with French and German abs.]: Anal. Chim. Acta, v. 52, no. 2, p. 349-355, illus., table, 1970.

A new ultraviolet spectrophotometric method for the determination of small amounts of rhenium has been proposed. The method is based on the formation of a rhenium-pyrrolidinedithiocarbamate complex in very acidic solution. Two procedures are given involving different final acidities and permitting absorbance measurements at 243 nm or 268 nm with corresponding molar absorptivities of 5.60×10^4 and 2.95×10^4 l mole^{-1} cm^{-1}, respectively. — Authors' abstract

Lilley, E. M. *See* Stephens, D. R. 06296

06190 **Lind, Carol J.** Specific conductance as a means of estimating ionic strength, *in* Geological Survey research 1970, Chap. D: U.S. Geol. Survey Prof. Paper 700-D, p. D272-D280, illus., tables, 1970.

In an aqueous solution each cation-anion combination has its own characteristic curve on a plot, made on a log-log scale, of ionic strength versus conductance. If the major ionic combinations are known for a particular salt solution or natural-water source, ionic strength can be estimated from such a plot of these major cation-anion combinations. If, on the basis of previous periodic analyses, the ionic composition has only dilution as the main variable, then a characteristic plot may be made for that salt solution or natural-water source and used for future estimations of its ionic strength. — Author's abstract

00030 **Lofgren, Gary.** Experimentally produced devitrification textures in natural rhyolite glass: Geol. Soc. America Bull., v. 82, no. 1, p. 111-123, illus., tables, 1971.

Cylinders of natural rhyolitic glass and either pure water or alkali-rich solutions were sealed in gold capsules and heated to temperatures between 240° and 700°C and pressure between 0.5 and 4 kb. Textures in the products of these experiments closely resembled hydration and devitrification textures in rhyolitic rocks, and include spherulites, micropoikilitic quartz, orbs, axiolites, and miarolitic cavities. — WHN

06260 **Logan, Lloyd M.; Hunt, Graham R.** Emission spectra of particulate silicates under simulated lunar conditions: Jour. Geophys. Research, v. 75, no. 32, p. 6539-6548, illus., table, 1970.

Infrared spectra have been acquired under simulated lunar conditions that demonstrate that, contrary to popular belief, features of high spectral contrast are available for small-particle-size samples. The spectral information occurs in the form of emission maximums that are associated with the principal Christiansen frequencies, and these maximums are diagnostic of gross composition. The features represent a 5 to 30 percent effect, depending on particle size and composition. The effect is explained in terms of the sharp thermal gradients produced close to the surface under lunar conditions. — Authors' abstract

06360 **Lord, James.** Real-time simulated earthquake motion of high rise structures: New Zealand Soc. Earthquake Eng. Bull., v. 3, no. 3, p. 95-106, illus., 1970.

The application of computer techniques to a dynamic analysis and simulation of the seismic response of an actual 52-story steel-framed tower in the Los Angeles area is discussed. The tower was modeled mathematically and excited by modeling ground shaking of the order expected from earthquakes of M = 4.5 through 8.5 on the Richter scale plus the 1940 El Centro earthquake record, M = 7.2. This real-time simulation allows a graphic display of dynamic behavior and characteristics of a structure, and simulation can be effected by using the Integrated Graphics Software System in conjunction with a Stromberg-Carlson 4060 computer recorder with conversion to hardware commands to produce a CRT graphic display in either a film record or hardcopy prints of frames. — VSN

Love, J. D. *See* McKenna, Malcolm C. 06208

06434 **Lovering, J. F.; Butterfield, D.** Neutron activation analysis of rhenium and osmium in Apollo 11 lunar material, *in* Apollo 11 Lunar Sci. Conf., Houston, Tex., 1970, Proc. — V. 2, Chemical and isotope analysis: New York, and Oxford, England, Pergamon Press (Geochim. et Cosmochim. Acta Supp. 1), p. 1351-1355, tables, 1970.

Neutron activation analyses for Re and Os in lunar volcanic rocks indicate abundances of 0.0016-1.7 ppb Re and 0.02-0.9 ppb Os which are generally within the range of concentrations observed in terrestrial rocks. These levels are strongly depleted relative to abundance levels in chondritic meteorites and imply some metal phase separation and segregation within the Moon if the Moon has an overall chondritic composition. Re and particularly Os levels observed in the secondary lunar rocks (that is, the breccias) and the surficial fine material indicate possible chondritic contamination levels of up to 2 wt. percent or iron meteorite contamination levels < 1 percent. — Authors' abstract

05957 **Lovering, T. S.** Memorial of Bronson F. Stringham — July 28, 1907-May 30, 1968: Am. Mineralogist, v. 55, nos. 3-4, p. 607-614, portrait, 1970.

06141 **Lowell, James D.** Antithetic faults in upthrusting: Am. Assoc. Petroleum Geologists Bull., v. 54, no. 10, p. 1946-1950, 1970.

Upthrusting causes small displacement faults to form antithetic to synthetic faults of larger displacement. Antithetic faults are well developed in clay models, predicted in analytical studies and can be observed in outcrops. The attitude and character of antithetical faults can be used to determine the attitude of the larger synthetic faults and the overall structure of the upthrust zone. — *from* Author's abstract

05908 **Lucia, F. Jerry.** Lower Paleozoic history of the western Diablo Platform of West Texas and south central New Mexico [summ.], *in* The geologic framework of the Chihuahua tectonic belt — Symposium in honor of Ronald K. De Ford, Midland, Tex., 1970: Midland, Tex., West Texas Geol. Soc., p. 20-22, 1970.

06231 **Ludwick, John C.** An empirical expression for the probability of particle passage through ideal screens — A reply [to N. C. Janke's 1970 discussion of "Particle shape and influence of size from sieving," 1968]: Sedimentology, v. 14, nos. 3-4, p. 323, 1970.

Ludwick and Henderson's paper was published in ibid., v. 11, p. 197-235, 1968 [1969]; Abs. North American Geology, May 1970; discussion by Janke, ibid., v. 14, p. 321-323, 1970; this issue.

06358 **MacDonald, A. B.; Sauer, E. K.** Engineering properties of tills, *in* Physical environment of Saskatoon, Canada: Natl. Research Council Canada Pub. 11378, p. 53-55, illus., 1970.

The few samples tested were taken from unoxidized, unweathered tills of the Battleford and Floral Formations and from oxidized, weathered till at the top of the Sutherland Group. The Battleford till is soft to stiff, massive, silty clay; the other tills are stiff to hard, fissured, silty clays. Atterberg Limits and grain size analyses suggest texture and composition of each unit is uniform at a specific site. The tills are well graded, with significantly more clay in the Sutherland till; they exhibit a fairly high shearing resistance. Stress-strain curves show that each unit has unique deformation characteristics; failure is generally symmetrical bulging in tills from the Saskatoon Group, and clearly defined rupture planes in the weathered Sutherland tills. Preconsolidation pressure is higher in the Floral than Battleford tills. — GDC

05856 **Macdonald, Gordon A.; Abbott, Agatin T.** Volcanoes in the sea — The geology of Hawaii: Honolulu, Univ. Hawaii Press, 441 p., illus., tables, 1970.

This book, intended for the general reader, discusses volcanic and other natural processes which formed the volcanoes of the Hawaiian Archipelago and which are continuously changing them. Volcanic eruptions are described and classified. The origin of molten magma in the upper part of the mantle and the changes it undergoes as it cools in its upward journey to the surface are discussed. Minerals associated with and the soils derived from lava rock and pyroclastic material, are described, as are weathering and erosion by stream, ocean, wind and ice. Chapters are devoted to the structural setting of the region, and to the geology of each of the main islands. — EH

MacDonald, Harold C. *See* Lewis, Anthony J. 05874

MacDougall, Doug. *See* Hawkins, James W. 00011

MacFarlane, R. D. *See* Gupta, M. C. 06442

06361 **MacIntyre, Ferren.** Why the sea is salt: Sci. American, v. 223, no. 5, p. 104-115, illus., 1970.

This semipopular review of the geochemistry of sea water notes that to date 73 elements in addition to hydrogen and oxygen have been identified in sea water. The salinity has been nearly constant for 200 million years. Geochemical cycles that keep marine ions closely in balance involve a complex interchange of material over decades, centuries, and millenniums among the atmosphere, ocean, rivers, crustal rocks, ocean sediments and ultimately the mantle. The global activities of men have now reached such a scale that they are beginning to have a profound effect on marine chemistry and biology. — DWR

06416 **MacKevett, E. M., Jr.** Geologic map of the McCarthy C-4 quadrangle, Alaska: U.S. Geol. Survey Geol. Quad. Map GQ-844, scale 1:63,360, separate text, sections, 1970.

Layered rocks in the McCarthy C-4 quadrangle form a sequence about 20,000 feet thick that includes abundant sedimentary shelf deposits; lavas and associated rocks reflecting three volcanic episodes; and less common continental sedimentary rocks, intrusive rocks, and surficial deposits; age range is from Permian(,) to Quaternary. Stratigraphy, structure, and map units are described in the text. There are no mines or prospects in the quadrangle. — MCM

06143 **Mackin, J. H.** Origin of pediments in the western United States, *in* Problems of relief planation (Márton Pécsi, editor) — Internat. Symposium, Budapest, 1968, Proc.: Budapest, Hungary, Akadémiai Kiado (Studies in Geography in Hungary 8), p. 85-105, illus., 1970.

Corrasion and weathering-wash pediments are end members in an isomorphous series; thus definition of a pediment should be not genetic, but descriptive — an erosion surface, planar or with low relief but high overall slope, that forms in arid or semiarid regions. As streams migrate in lateral planation, gravel is left behind, its thickness near the maximum depth of flood scour; lateral cutting by arid-region streams is rapid. Pediments form by sheet wash on rocks that weather to grus, easily removable during cloudbursts; the stripped rock surface of minor relief looks like a smooth erosion surface. The sharp angle at mountain front is maintained by: lateral stream planation that truncates spurs, washing of scarp, sapping of upper resistant layer, formation of residual armor of boulders, and/or tor effect. Both pediments and piedmont fans are convex-upward, slopes of transportation. — GDC

MacLean, Brian. *See* King, Lewis H. 05868

06182 **Madsen, Beth M.; Murata, K. J.** Occurrence of laumontite in Tertiary sandstones of the central Coast Ranges, California, *in* Geological Survey research 1970, Chap. D: U.S. Geol. Survey Prof. Paper 700-D, p. D188-D195, illus., tables, 1970.

Authigenic laumontite, occurring in Miocene Vaqueros and Briones Sandstones of the central Coast Ranges, replaces clastic plagioclase and is an intergranular cement in the arkosic Vaqueros Sandstone, where it formed mainly through diagenetic alteration of plagioclase. In addition to laumontite of such origin, Briones Sandstone, which contains much andesitic debris, has an unusual laumontite-chlorite filling of pores. Laumontite lines pores and envelops cores of sheaflike aggregates of chlorite, most likely produced through interaction of montmorillonite and calcite. Variations in composition and permeability of sandstones are major causes of irregular distribution of laumontite in these small occurrences. A new 'staining' technique involves treatment of thin sections or polished slabs with a 10-percent solution of oxalic acid; this selectively deposits finely crystallized calcium oxalate on laumontite. — *from* Authors' abstract

06376 **Maher, Stuart W.** Barite resources of Tennessee: Tennessee Div. Geology Rept. Inv. 28, 40 p., illus., tables, 1970.

Barite deposits in 34 counties of Tennessee are in host rocks of Precambrian to Mississippian age. The most productive of 70 known mines are open cuts in clay residuum overlying the Kingsport Formation of Early Ordovician age in the Sweetwater district in eastern Tennessee. Total production since 1870 is estimated at 1,750,000 tons, with reserves sufficient for many years. Barite occurs in breccia fillings, in vein and in deposits that may be bedded. When weathered these occurrences can form residual deposits, especially if the host is carbonate rock. Some deposits contain galena, fluorite, sphalerite, pyrite and, commonly, silica. Deposits were possibly formed by barium ions expelled from deeply-buried feldspars during heating, or by submarine exhalations. — *from* Author's abstract

Major, C. F., Jr. *See* Bernard, Hugh A. 05896

Major, C. F., Jr. *See* Bernard, Hugh A. 05897

05926 **Malaurie, J.** Complexité des notions de faciès morphologique arctique et subarctique (nord-ouest et centre-ouest du Groenland) [Complexities of the concepts of arctic and subarctic morphologic facies (northwest and west-central Grenland) (with English abs.)], *in* Ecology of the subarctic regions (Écologie des regions subarctiques) — Helsinki, Symposium, Proc.: Paris, UNESCO, p. 125-128, 1970.

For a definition of the arctic and the subarctic, criteria of different branches of natural sciences should be taken into account in their complexity and inter-relationships. A definition based only on data from one limited field will never be sufficient and can lead to unfortunate misunderstandings and mistakes. — Author's English summary

06335 **Malek-Aslani, Morad.** Lower Wolfcampian reef in Kemnitz field, Lea County, New Mexico: Am. Assoc. Petroleum Geologists Bull., v. 54, no. 12, p. 2317-2335, illus., 1970.

The Kemnitz field produces from a stratigraphic trap formed by updip loss of porosity in an early Wolfcampian (Permian) shelf-margin barrier-reef that was draped over a north-plunging structural nose at the north end of the Delaware basin. Facies studies, and application of material balance calculations of organic content in analogous Holocene shelf carbonates, indicate that hydrocarbons generated *in situ* in the 140-mi Kemnitz-Townsend reef tract and migrated to the porous reef-wall facies in late Wolfcampian time. — BHK

06290 **Manatt, Stanley L.; Elleman, Daniel D.; Vaughan, Robert W.; Chan, Sunney I.; Tsay, Fun-Dow; Huntress, Wesley T., Jr.** Magnetic resonance studies of lunar samples, *in* Apollo 11 Lunar Sci. Conf., Houston, Tex., 1970, Proc. — V. 3, Physical properties: New York, and Oxford, England, Pergamon Press (Geochim. et Cosmochim. Acta Supp. 1), p. 2321-2323, illus., 1970.

Electron spin resonance searches at 9.5 Ghz on several fines samples and portions of several rocks have yielded signals whose lineshapes and temperature dependences show that the samples are principally ferromagnetic in nature. Proton magnetic resonance searches at 60 Mhz of these samples have not revealed any signals ascribable to water or any other types of hydrogen in concentrations greater than 0.0001 percent by weight contained in narrow lines (5 oe wide or less) and 0.01 percent by weight in wide lines (as wide as 100 oe). — Authors' abstract

05937 **Manconi, John W.; McDougall, David J.** Thermal activation energy of shocked and strained quartz: Am. Mineralogist, v. 55, nos. 3-4, p. 398-402, illus., tables, 1970.

The thermal activation energy calculated by the initial rise method appears to be an indication of the state of deformation in quartz from shocked and strained quartzites. The data suggest that undeformed material from two widely separated sources have approximately equal eV values. On the basis of preliminary data similar results can probably be obtained from other rock types. — Authors' abstract

06237 **Mankin, Charles J.** Alex. Nicholson, Jr., 1921-1970: Oklahoma Geology Notes, v. 30, no. 6, p. 151-152, portrait, 1970.

05790 **Mann, C. John.** Isochronous, synchronous, and coetaneous: Jour. Geology, v. 78, no. 6, p. 749-750, 1970.

In the semantics of chronostratigraphy, the adjective "isochronous" should be employed in the sense of a uniform length of time, or of equal duration, but not necessarily contemporaneous. "Synchronous" should be restricted to events of short duration that occur simultaneously, such as a synchronous surface. "Coeval" and ". coetaneous," which are close synonyms, should be used to describe a rock unit bounded by synchronous surfaces. — VES

Manson, A. J. *See* Runcorn, S. K. 06292

06397 **Mao, Nai-Hsien.** Empirical equation of state for high compression: Jour. Geophys. Research, v. 75, no. 35, p. 7508-7512, tables, 1970.

An empirical equation of state for high compression is derived from the assumption that $K(\delta P/\delta K) = a + bP$ where $K = -V(\delta P/\delta V)$. When $b = 1$, it reduces to the Murnaghan's assumption. The second pressure derivative of bulk modulus is needed in the equation. Since this quantity is generally not available, a method is proposed to estimate it from other readily available data and the relation that Gruneisen's parameter γ is a function of volume alone. As examples, NaCl, MgO, CsI, and potassium are used to test the equation. Good agreement is found for all of them compared with values in the literature. — *from* Author's abstract

Marchant, L. C. *See* White, E. J. 05983

06172 **Marinenko, John; May, Irving.** Gas chromatographic determination of carbonate carbon in rocks and minerals, *in* Geological Survey research 1970, Chap. D: U.S. Geol. Survey Prof. Paper 700-D, p. D103-D105, illus., table, 1970.

A simple, rapid, and direct gas chromatographic method for determining carbonate carbon in rocks and minerals was developed. Powdered samples are heated with phosphoric acid, and evolved gases are separated on a silica-gel column. Carbon dioxide is detected by thermal conductivity using helium as a carrier gas. The method is most applicable for determining carbon dioxide when only a limited quantity of sample is available. As little as 2 micrograms of carbon dioxide can be determined. — Authors' abstract

06003 **Marjaniemi, Darwin Keith.** Geologic history of an ash-flow sequence and its source area in the Basin and Range Province of southeastern Arizona [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 12, pt. 1, p. 5557B, 1970.

Marlow, Michael S. *See* Scholl, David W. 05962

05963 **Martin, A. J.** Structure and tectonic history of the western Brooks Range, De Long Mountains and Lisburne Hills, northern Alaska: Geol. Soc. America Bull., v. 81, no. 12, p. 3605-3621, illus., tables, geol. map, 1970.

Seven distinct but roughly coeval stratigraphic sequences from Upper Devonian to Lower Cretaceous can be recognized. The Brooks Range and De Long Mts. constitute distinct provinces; compressional tectonics characterize the former, gravity-slide tectonics the latter. Gravity-slide sheets have been dislocated 60 to 70 mi. Orogeny initiated in the Jurassic was marked by emplacement of an ophiolitic suite. Flysch trough subsidence by earliest Cretaceous flanked a geanticline centered on the Baird Mts. Subsidence continued throughout Cretaceous with migration northward of the axes of subsidence. Compressional overthrusting developed in sequences that were downwarped. Where downwarping was prolonged or strongly developed gravity sliding took place. Gravity slides of the De Long Mts. are postulated to override the Brooks Range "spine." — *from* Author's abstract

06218 **Martin, Charles W.** The bedrock geology of the Torrington quadrangle (with map): Connecticut Geol. and Nat. History Survey Quad. Rept. 25, 53 p., illus., tables, geol. map, 1970.

The Torrington quadrangle contains a sequence of metavolcanic and metasedimentary rocks intruded by two kinds of granite, which include the Gneiss Complex of the Berkshire Highlands (Precambrian,) with three stratigraphic units, the Waramaug Formation, also consisting of gneiss (Lower Paleozoic,), which has not been subdivided, and the Hartland Formation (Lower Paleozoic) with three units, from lowest to highest consisting of gneiss, schist and a mixture of schist, granulite and granulitic gneiss. A little Tyler Lake Granite (Middle Paleozoic) occurs. The Nonewaug Granite (Middle Paleozoic) is late- to posttectonic. Structure is dominated by a southward-plunging anticline in the Gneiss Complex and an overturned, isocline to the southeast. Small folds are common, but there is no evidence of major faulting. — *from* Author's abstract

Marvin, Richard F. *See* Lee, Donald E. 06209

06135 **Mason, Brian; Graham, A. L.** Minor and trace elements in meteoritic minerals: Smithsonian Contr. Earth Sci., no. 3, 17 p., illus., tables, 1970.

Nickel-iron, troilite, olivine, pyroxenes, plagioclase, chromite, and phosphate minerals (chlorapatite and/or merrillite) have been separated from a number of meteorites (Modoc, St. Severin, Winona, Haraiya, Marjalahti, Springwater, Johnstown, Mt. Egerton, Soroti) and analyzed for minor and trace elements with the spark-source mass spectrometer. The elements Ni, Co, Ge, As, Ru, Rh, Pd, Sn, Sb, W, Re, Os, Ir, Pt, and Au are concentrated in nickel-iron; Se and Ag in troilite; Th, U, and the lanthanides in the phosphate minerals and in diopside; Eu, Sr, Ba, Rb, and Cs in plagioclase. Molybdenum and tellurium are concentrated in nickel-iron and troilite. The elements Ti, Sc, V, Cu, Zn, Mn, and Ga are distributed over several coexisting minerals. — Authors' abstract

Masson, S. *See* Card, K. D. 06421

Masson, S. *See* Card, K. D. 06422

06131 **Matthews, John V., Jr.** Quaternary environmental history of interior Alaska — Pollen samples from organic colluvium and peats: Arctic and Alpine Research, v. 2, no. 4, p. 241-251, illus., table, 1970.

Thick sequences of late Pleistocene frozen silts and peats are exposed in many areas of forested interior Alaska. Pollen samples from such sediments show that an arctic environment once prevailed in large areas of lowland interior Alaska. Furthermore, a few of these pollen samples are referred to Livingstone's Herb Zone, suggesting that the Late Wisconsin environment was similar in some respects to that of present day Barrow, Alaska; during that time, spruce woodlands would have been nearly eliminated. Two of the pollen samples represent forested conditions; one, of probable interglacial age, provides the first evidence of a westward advance of pines during the Pleistocene. Surface samples are presented for comparison with the fossil pollen samples. — *from* Author's abstract

May, Irving. *See* Marinenko, John. 06172

McAllister, James F. *See* Erd, Richard C. 05934

05920 **McAnulty, W. N., Sr.** The mineral potential of the Chihuahua tectonic belt [summ.], *in* The geologic framework of the Chihuahua tectonic belt — Symposium in honor of Ronald K. De Ford, Midland, Tex., 1970: Midland, Tex., West Texas Geol. Soc., p. 70-75, 1970.

05784 **McCabe, Robert A.** Beach behavior, north shore, Long Island Sound: Am. Soc. Civil Engineers Proc., v. 96, paper 7679, Jour. Waterways, Harbors and Coastal Eng. Div., no. WW4, p. 781-794, illus., tables, 1970.

Artificial beaches along the north shore [Connecticut] of Long Island Sound demonstrated significant natural patterns of beach behavior. Wave action produced slopes of about 1 in 10 between low water and about 5 feet above high water. Low tide benches formed offshore. Groins and other barriers retained sand up to the point

where overtopping occurred within range of common wave action. Where beaches were placed at a skew to resultant wave direction, wave action caused them to rotate and assume a position facing the wave direction. The resulting beach widths were determined either by the capacities of the barriers' ends or by the quantity of sand involved, whichever was the limiting factor. Construction practices and the survey program also are briefly described. — ASCE abstract

06457 **McCary, Charles E. L.** Mineral resources summary of the Boonshill quadrangle, Tennessee: Nashville, Tenn., Tennessee Div. Geology, 4 p., 1970.

This summary which accompanies Tennessee Div. Geology Geol. Map GM 73-NW (R. H. Barnes, cited separately) describes the Ordovician limestone formations that crop out in the Boonshill quadrangle (Bigby-Cannon and Carters). Potential resources are gravel and chert. — MCM

McCord, Thomas B. *See* Adams, John B. 06266

06004 **McDole, Robert Elroy.** Loess deposits adjacent to the Snake River flood plain in the vicinity of Pocatello, Idaho [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 12, pt. 1, p. 5557B, 1970.

McDougall, David J. *See* Manconi, John W. 05937

McEvilly, T. V. *See* Carder, D. S. 06410

05815 **McKee, Edwin H.** Fish Creek Mountains Tuff and volcanic center, Lander County, Nevada: U.S. Geol. Survey Prof. Paper 681, 17 p., illus., tables, 1970.

Fish Creek Mts. are the site of an early Miocene volcano (about 24 m.y. old) from which was erupted about 75 cu mi of crystal-rich rhyolite ash-flow tuff, here named the Fish Creek Mts. Tuff. The formation appears to be a composite sheet, although most was erupted during a short period of time and cooled as a large, nearly homogeneous body. Two cooling units are separated by a cooling break and can be distinguished in most places by a large amount of lithic debris in the lower unit. The ash flow spread outward uniformly in all directions from a vent area in the south-central part of the range; collapse of this vent area probably accompanied eruption; the depression formed acting as a trap for continued eruption of similar tuff. Evidence of resurgence of the vent area is unclear, although tectonic activity probably related to the final phase of volcanism is evident. Several long, arcuate faults may be remnants of a caldera structure. — *from* Author's abstract

McKee, Edwin H. *See* Noble, Donald C. 06164

06208 **McKenna, Malcolm C.; Love, J. D.** Local stratigraphic and tectonic significance of *Leptoceratops*, a Cretaceous dinosaur in the Pinyon Conglomerate, northwestern Wyoming, *in* Geological Survey research 1970, Chap. D: U.S. Geol. Survey Prof. Paper 700-D, p. D55-D61, illus., 1970.

An unabraded tooth of *Leptoceratops*, a small hornless dinosaur of latest Cretaceous age, found in place 150 feet above the base of the Pinyon Conglomerate in its principal reference section on the east side of Pinyon Peak, necessitates a reevaluation of the age of at least part of the Conglomerate, because 30 mi southeast of Pinyon Peak the Pinyon contains Paleocene fossils at its base and top. Lack of abrasion of the specimen and absence of dinosaurs from rocks of undisputed Paleocene age suggest at least the basal 150 feet of the 3,700-ft-thick Pinyon Conglomerate in the type locality is Cretaceous. Angularity of the unconformity at the base of the Pinyon ranges from very little at the dinosaur locality to 90° about 3 mi southeast. It seems probable that tectonic activity that produced Washakie Range and Buffalo Fork thrust fault began as early as latest Cretaceous time. — *from* Authors' abstract

McKeown, F. A. *See* Bucknam, R. C. 06077

05839 **McLean, J. S.** Objectives of a current study of saline ground water in the Tularosa Basin, New Mexico, *in* New Mexico Water Resources Research Inst., 15th Ann. Water Conf., 1970, Proc.: Las Cruces, N.Mex., New Mexico State Univ., p. 95-100, illus., 1970.

The Tularosa Basin, a north-trending valley in south-central New Mexico, comprises about five percent of the Rio Grande basin in the United States. Average rainfall ranges from 8 inches in the center to 25 inches on the high mountain slopes. The basin is a graben, initiated in mid-Tertiary time and filled with 6,000 feet of alluvial detritus, the most important aquifer in the basin. Fresh ground-water supplies are limited, and will be insufficient if withdrawals continue at the present rate. Only alluvial fan materials around the margins of the basin are saturated with fresh water; the rest contains saline water, the potential of which is being studied. — ESL

06123 **McLean, W. John.** Confirmation of the mineral species wherryite: Am. Mineralogist, v. 55, nos. 3-4, p. 505-508, tables, 1970.

The unit cell of wherryite is $a = 20.82$, $b = 5.79$, $c = 9.17$ A, $\beta = 91°17'$; space group $C2$, Cm, or $C2/m$. Wherryite may be related to leadhillite. — Author's abstract

McNulty, C. L., Jr. *See* Powell, J. Dan. 06030

00016 **McPherson, H. J.** Downstream changes in sediment character in a high energy mountain stream channel: Arctic and Alpine Research, v. 3, no. 1, p. 65-79, illus., tables, 1971.

Rapid downstream changes in particle size, form, sorting, and grain size distribution occur in bed sediments of Two O'Clock Creek in the Canadian Rockies. These changes are related to distance from the stream mouth, bed slope, and rock lithology. Pebble size, maximum projection area, and sorting alter systematically downstream while pebble roundness and flatness do not change. Particle size, maximum projection area, roundness, and sorting correlate significantly with bed slope, with the larger, better rounded and more poorly sorted gravels occurring on the steeper channel segments. Rock lithology correlates better with pebble size, maximum projection area, roundness, and flatness than does either distance from the stream mouth or local bed slope, proving it to be the most important factor influencing particle character. The high degree of variance displayed by the relationships probably reflects the addition of fresh material to the stream along its course. — *from* Author's abstract

00002 **McTaggart, Kenneth C.** On the origin of ultramafic rocks: Geol. Soc. America Bull., v. 82, no. 1, p. 23-41, illus., table, 1971.

It is proposed that most alpine ultramafic bodies originated as cumulates in basic magma chambers high in the crust. From some chambers, magmas were intruded upward or extruded, leaving sill-like ultramafites behind. Some ultramafites were subsequently folded or dismembered by faulting, and because of their high density, subsided during tectonism to form cold intrusions. In other places, tectonism interrupted crystallization of the magmas and the hot cumulates slid, working down fault zones. These hot masses were subject to high temperature recrystallization and metasomatism, as water permeated them, forming veins of pyroxenite and dunite, and destroying intercumulus plagioclase. Contact aureoles were formed, but some were abandoned as the cooling ultramafites descended. — RAL

Melhorn, Wilton N. *See* Coffman, Daniel M. 06100

Mello, James F. *See* Owens, James P. 05860

05901 **Melvin, Robert L.** Hydrogeologic data for the upper Housatonic River basin, Connecticut: Connecticut Water Resources Bull. 22, 33 p., illus., tables, 1970.

This report, containing records of 284 wells and 5 springs, logs of 322 wells and test holes, mechanical analyses of 58 sediment samples of stratified drift, and records of 3

pumping tests, supplements interpretive results published ibid., no. 21 (in press). — MCM

06356 **Meneley, W. A.** Groundwater resources, *in* Physical environment of Saskatoon, Canada: Natl. Research Council Canada Pub. 11378, p. 39-50, illus., 1970.

Surficial aquifers in the Saskatoon area include stratified sand, silt, and clay deposits and alluvium in the Moose Woods Flats which overlie the uppermost till unit; water from precipitation infiltrates to recharge deeper aquifers or to discharge in local depressions, its composition varying with the lithology in its flow path. Deeper aquifers are: the Forestry Farm, within the Floral Formation; the Dalmeny, an intertill between the Saskatoon and Sutherland Groups; and the preglacial Tyner Valley system. The latter, the most extensive and potentially most productive, includes deposits of the Empress and Sutherland Groups along the buried valley and tributaries, and the Oldman Formation which forms the valley walls. The water is naturally softened by ion exchange in the Oldman Formation, which diverts its flow northward and west to the North Saskatchewan River. Water-level fluctuations are interpreted. — GDC

Meneley, W. A. *See* Christiansen, Earl A. 06357

06212 **Meyer, Henry O. A.** Géochimie des inclusions minérales dans les diamants naturels [Geochemistry of mineral inclusions in natural diamonds]: Assoc. Française Gemmologie Bull. 22, p. 8-10, table, 1970.

This paper is a summary of the research at Carnegie Institution of Washington Geophysical Laboratory by Meyer and Boyd (1968, 1969) on mineral inclusions in diamonds, considered as possible samples of the upper mantle. Electron microprobe analytical data are given for olivine (forsterite), garnets (8 end members), chromites (6 end members) and orthopyroxene (enstatite) extracted by oxidation from the host diamond at 750-850°C. Two important characteristics are noted: remarkable chemical similarity of inclusions of each mineral type, regardless of geographic locality and geologic age of the host diamond; very high chromium content of inclusions relative to that of enclosing kimberlite or ultramafic xenoliths in it. Possible bearings on mantle homogeneity and on mode and depth of diamond genesis are discussed. — VMJ

05798 **Meyerhoff, Howard A.** Continental margins — Discussion [of papers by K. O. Emery, et al.; H. D. Hedberg; P. A. Rona, 1970]: Am. Assoc. Petroleum Geologists Bull., v. 54, no. 11, p. 2214, 1970.

The papers under discussion were published *in* ibid., v. 54, no. 1, p. 44-108; 3-43; and 129-157, respectively, 1970; *see* Abs. North American Geology, July 1970.

06423 **Meyn, H. D.** Sweeny Township, District of Sudbury: Ontario Dept. Mines and Northern Affairs Prelim. Geol. Map P. 617, scale 1 in. to 1/4 mi., text, 1970.

Sweeny, Beaumont, and Beresford Townships are underlain by Precambrian rocks of various ages with a discontinuous cover of Pleistocene to Holocene deposits of sand, gravel, clay, and organic matter. The metavolcanics generally possess a well developed steeply dipping to vertical foliation; abundant pegmatite dikes are present in granitic rocks. No minerals of economic interest have been located. — MCM

06424 **Meyn, H. D.** Beaumont Township, District of Sudbury: Ontario Dept. Mines and Northern Affairs Prelim. Geol. Map P. 618, scale 1 in. to 1/4 mi., text, 1970.

The text for Beaumont Township is the same as for Sweeny Township; *see* Meyn, ibid., p. 617, 1970.

06425 **Meyn, H. D.** Beresford Township, District of Sudbury: Ontario Dept. Mines and Northern Affairs Prelim. Geol. Map P. 619, scale 1 in. to 1/4 mi., text, 1970.

The text for Beresford Township is the same as for Sweeny Township; *see* Meyn, ibid., p. 617, 1970.

06307 **Meyrowitz, Robert.** A pyrocatechol violet spectrophotometric procedure for the direct microdetermination of aluminum in silicate minerals, *in* Geological Survey research 1970, Chap. D: U.S. Geol. Survey Prof. Paper 700-D, p. D225-D229, illus., tables, 1970.

The Al_2O_3 content of 3-5-mg samples of common silicate minerals is determined spectrophotometrically by a direct pyrocatechol violet procedure. The sample is decomposed by sodium hydroxide fusion in a gold crucible, and a hydrochloric acid solution of the melt is used for determination at a pH of 6.0. Of common rock-forming elements present in most silicate minerals, only iron, titanium, and fluorine interfere; fluorine in concentrations found in most minerals does not interfere. Titanium and iron interference is overcome by adding titanium and iron contents of the sample to standard aluminum solutions used for the standard aluminum curve. Absorbance is measured at 580 μ. Beer's law is obeyed within the range of 0.2-0.8 ppm Al_2O_3. Tolerances of 48 elements were determined. Sensitivity is 0.00045 mμg Al/cm^2; suitability of the procedure was tested using nine standard silicate minerals and rocks. — *from* Author's abstract

Middleton, Gerard V. *See* Parkash, Barham. 06341

05838 **Miller, Maynard M.** 1946-1962 survey of the regional pattern of Alaskan glacier variations, *in* National Geographic Society research reports 1961-1962: Washington, D.C., Natl. Geog. Soc., p. 167-189, illus., tables, 1970.

Glacier regime studies, carried out from 1946-62 on 174 major glaciers through the Alaskan Panhandle from Wrangell Narrrows to Cook Inlet are summarized by district. The dominant characteristic of most termini during the past 50 years has been shrinkage. Recessional rate, especially of glaciers having source neves at low elevation, became accelerated in the 1920's; for many with high neves, a slower retreat occurred in the 1920's and 30's; a few have experienced spasmodic readvances since 1938. Strong departures from the general trend have been on some of the largest trunk glaciers, but with corresponding retreat of another valley glacier of comparable size, and with both glaciers derived from the same or adjoining neves. The proportion of equilibrium and advancing glaciers in Alaska is much higher than in any other glacier region in the world; the causal factor is of regional proportion and perhaps of global significance. — MCM

00028 **Miller, Ralph L.; Roen, John B.** Geologic map of the Keokee quadrangle, Virginia-Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-851, scale 1:24,000, section, text, 1971.

Coal, the only mineral resource mined in the Keokee quadrangle in recent years, is present in numerous beds of varying thickness; the most productive bed has been the Taggart. Although there has been no drilling for oil and gas, both have been found in nearby areas; most promising for oil is the Ordovician Trenton Limestone, and for gas, the Mississippian Greenbrier Limestone and Mississippian and Devonian Chattanooga Shale. Limestone and dolomite suitable for road metal and other construction uses are abundant in Ordovician carbonate formations. — MCM

05995 **Milligan, James Homer.** Optimizing conjunctive use of groundwater and surface water [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 12, pt. 1, p. 5489B, 1970.

05837 **Millot, Georges.** Geology of clays — Weathering, sedimentology, geochemistry (translated from French by W. R. Farrand and Hélene Paquet): New York and Berlin, Springer-Verlag, 429 p., illus., tables, 1970.

The aim of this text is to present an up-to-date compilation of work done throughout the world on the origin and development of clays. Chapter headings are: clay minerals; argillaceous rocks; geochemistry of ions in the hydrosphere; place of clays in the geochemical cycle; weathering and soil clays; clays of continental sediments; clays of marine sediments; evolution of the clay fraction in some great sedimentary series; silicifications, flint and growth of crystals; genesis of clay minerals — inheritance and transformation; genesis of clays — neoformation and syntheses; and

superficial geochemistry and the silicate cycle. A 37-page bibliography is appended. — MCM

Minard, James P. *See* Owens, James P. 05860

Minard, James P. *See* Sirkin, Leslie A. 06170

00012 **Misch, Peter.** Porphyroblasts and 'crystallization force' — Some textural criteria: Geol. Soc. America Bull., v. 82, no. 1, p. 245-251, illus., 1971.

The relative age of porphyroblasts and the fabric of their matrix is discussed with special reference to the bowing-out of a pre-existing schistosity plane by the growing porphyroblast. It is held that this texture cannot be explained by a later tectonic flow of the matrix around pre-existing porphyroblasts, if these porphyroblasts include an early replacement pattern. The conclusion that these porphyroblasts pushed out the surrounding schistose layers during their late growth is supported by the fact that the bowed-out layers are attenuated by "pressure solution," compensated by mineral matter precipitation in the lee of the porphyroblasts. — AH

05949 **Mitchell, G. P.; Graham, A. R.** Memorial of Horace John Fraser — November 27, 1905-February 2, 1969: Am. Mineralogist, v. 55, nos. 3-4, p. 554-651, portrait, 1970.

Mitchell, J. K. *See* Costes, N. C. 06272

05786 **Mitchell, R. H.** Kimberlite and related rocks — A critical reappraisal: Jour. Geology, v. 78, no. 6, p. 686-704, illus., table, 1970.

A new definition of kimberlite excludes alnoitic and lamprophyric members of carbonatite complexes. Under this definition kimberlites are not directly related to these rocks or to basalts, potassic volcanic rocks, melilites, or mica peridotites. — REW

Miyajima, M. *See* Hoyt, H. P., Jr. 06287

05890 **Monkhouse, F. J.** A dictionary of geography (2d edition): Chicago, Ill., Aldine Publishing Co., 378 p., illus., 1970.

This dictionary defines terms related to landforms; oceanography; climate and weather; cartography and surveying; Earth as a spheroid; scales, units, dimensions; soil; vegetation and biogeography, economic geography, human geography, population and settlement; town- and country-planning, political and historical geography; archeology; geography and methodology, geographical thought. Some 572 terms have been added to the initial 3400 entries of the first edition. — VSN

05842 **Montalbetti, James F.; Kanasewich, Ernest R.** Enhancement of teleseismic body phases with a polarization filter: Royal Astron. Soc. Geophys. Jour., v. 21, no. 2, p. 119-129, illus., 1970.

A time domain polarization filter, originally proposed by Flinn, has been modified and is used to increase the signal to noise ratio of teleseismic body phases. Both rectilinearity and direction of particle motion is obtained from the co-variance matrix for three components of ground motion over a small time interval. The estimate of rectilinearity is found by diagonalizing the matrix and forming a function that involves the ratio of the largest and intermediate principal axes of the matrix. The direction of polarization is found from the eigenvector of the largest principal axis. A set of time-varying operators are then obtained which act as a point by point gain control to modulate the digital seismic records. This nonlinear filter is useful for enhancing P, pP, $_{s}$P, PP, S, and other compressional or shear phases. When applied to an array of three-component stations it appears possible to identify multiple events in the source function of some earthquakes. — Authors' summary

06328 **Moody, J. D.** Petroleum demands of future decades: Am. Assoc. Petroleum Geologists Bull., v. 54, no. 12, p. 2239-2245, illus., table, 1970.

During the next 20 years the Free World will consume 500 billion bbl of oil, or about 80 percent of estimated present reserves. By 1990 consumption will be 98 million bbl per day, or about 2 3/4 times present production, and maintaining a 10-15 to 1 ratio of reserves to production will require discovery of half again as much oil in the next 20 years as was discovered 1860-1970. The 600 billion bbl ultimate recovery expected from the Free World's 161 giant oil fields represents 78 percent of the total so far established; the total Free World potential, with no allowance made for economic or political restraint, is estimated to be 550 billion bbl. But 101 of these giant fields were discovered since 1940, and recovery expected from them is 413 billion bbl. Increased emphasis on use and development of new geologic concepts and new exploration techniques should result in finding many new giants. The continental margins are the best places to look. — BHK

05876 **Mooney, Harold M.; Farnham, Paul R.; Johnson, Stephen H.; Volz, Gary; Craddock, Campbell.** Seismic studies over the Midcontinent Gravity High in Minnesota and northwestern Wisconsin: Minnesota Geol. Survey Rept. Inv. 11, 191 p., illus., 1970.

Seismic refraction data from 87 profiles aid in delineating geologic structures causing gravity and magnetic anomalies associated with the northern part of the Midcontinent Gravity High. Interpretation of the data shows a maximum depth of about 10,000 feet to the igneous basement and defines structure within the sedimentary section. Seismic traveltime data, an inferred geologic structure section, and a discussion are included for each profile. Tabulated values for seismic velocities range from 9,000-23,000 feet per second. Velocities are assigned to seven groups of strata: Paleozoic; upper, middle, and lower Upper Keweenawan sedimentary strata; Middle Keweenawan volcanics; pre-Keweenawan felsic intrusives; and pre-Keweenawan mafic intrusives. Good velocity correlations are established between similar strata in different geologic provinces. — *from* Authors' abstract

Moore, D. G., Jr. *See* Heinrich, E. William. 06116

Moore, Roosevelt. *See* Jenkins, Lillie B. 06186

Moores, E. M. *See* Valentine, J. W. 06450

06385 **Moores, Eldridge.** Ultramafics and orogeny, with models of the US Cordillera and the Tethys: Nature, v. 228, no. 5274, p. 837-842, illus., 1970.

Temple and Zimmerman (unpublished) have proposed that emplacement of ultramafic rocks in mountain systems may be achieved by collision of continental margin with a subduction zone dipping away from the continent rather than towards it, as is more common. This article applies the hypothesis to a preliminary analysis of the Alpine and Cordilleran systems. The diverse and apparently conflicting features of the Cordilleran orogen can be fitted into a model in which a North American continent with a Japan- or Andes-style margin has collided three times in Phanerozoic time with a subduction zone dipping the other way. This continental margin is reflected in the eugeosynclinal-miogeosynclinal suite, and the intersections are represented by large ultramafic-mafic masses and the eastward directed orogenies. Several important implications for orogeny are outlined. — DBV

Morris, Hugh C. *See* Bishop, Donald. 06064

06262 **Morrison, J. A.; Norton, P. R.** The heat capacity and thermal conductivity of Apollo 11 lunar rocks 10017 and 10046 at liquid helium temperatures: Jour. Geophys. Research, v. 75, no. 32, p. 6553-6557, table, 1970.

Heat-capacity measurements made on portions of lunar rocks 10017 and 10046 in the temperature region 2° to 5°K are over 100 times greater for both than predicted from acoustic wave velocities measured in the same rocks. Several possible reasons are considered. It is concluded that the effect originates in the existence of one or more small peaks in the low-frequency part of the vibrational frequency distribution. The "excess" heat capacity of rock 10017 can be accounted for semiquantitatively

by one such peak containing 3 percent of the normal modes at a frequency of 5 cm^{-1}. Thermal equilibrium in rock 10046 was sufficiently slow to allow a good estimate to be made of thermal conductivity. The result, $K = 2.5 (\pm 0.5) \times 10^{-6}$ cal per sec cm degree, is compared with values obtained by other techniques. Thermal conductivity of rock 10017 was found to be 10 to 100 times larger. — *from* Authors' abstract

06396 **Mozola, Andrew J.** Geology for environmental planning in Monroe County, Michigan: Michigan Geol. Survey Rept. Inv. 13, 34 p., illus., tables, geol. map, 1970.

Monroe County in southeastern Michigan is underlain by Paleozoic strata dipping gently northwest. The stratigraphic sequence consists of carbonate rocks, sandstones, and shales. Bedrock is almost completely veneered by glacial drift from a few inches to nearly 160-feet thick, but generally less than 30-feet thick. A few widely scattered natural rock exposures occur. Except in principal urban areas, domestic water supplies are obtained from wells in bedrock. As wastes are disposed of in septic tanks, ground water is vulnerable to contamination. Knowledge of geologic conditions is crucial in land-use planning. A series of county maps depicting bedrock geology, bedrock topography, drift thickness, glacial geology, and piezometric water level, a small bedrock map of the state and a stratigraphic nomenclature chart are included. — *from* Author's abstract

Muan, A. *See* Navrotsky, A. 06388

05974 **Mudge, Melville R.** Origin of the disturbed belt in northwestern Montana — Reply [to discussion by R. Scholten of 1970 paper]: Geol. Soc. America Bull., v. 81, no. 12, p. 3793, 1970.

For the paper under discussion, *see* ibid., v. 81, no. 2, p. 377-392, 1970; Abs. North American Geology, July 1970. Discussion by R. Scholten, ibid., v. 81, no. 12, p. 3789-3792, 1970.

05906 **Muehlberger, W. R.; Wiley, M. A.** The Texas lineament [summ.], *in* The geologic framework of the Chihuahua tectonic belt — Symposium in honor of Ronald K. De Ford, Midland, Tex., 1970: Midland, Tex., West Texas Geol. Soc., p. 8-15, illus., 1970.

Muehlberger, William R. *See* Flawn, Peter T. 06026

06301 **Mueller, George; Hinsch, Gertrude W.** Glassy particles in lunar fines: Nature, v. 228, no. 5268, p. 254-258, illus., tables, 1970.

Most of the Apollo 11 glassy particles differ from those generated by terrestrial volcanism, meteor impacts, or condensation of meteorite parent bodies. Some may have been formed by the action of solar flares on the lunar surface. The solar flare origin implies the possibility that the depletion of volatiles in the Apollo 11 and 12 basalts would be at least partially caused by solar evaporation. A decrease of spray particles and an increase of volatiles, including organic molecules, may therefore be anticipated with increasing depth below the lunar surface, and also at the surface of areas which were not close to the equator at any time in the Moon's history. — DBV

Muir, A. H., Jr. *See* Housley, R. M. 06286

Mukherjee, N. R. *See* Grossman, J. J. 06281

06126 **Mumme, W. G.** The crystal structure of $SnTa_2O_7$, thoreaulite, an example of tin in five-fold coordination: Am. Mineralogist, v. 55, nos. 3-4, p. 367-377, illus., tables, 1970.

$SnTa_2O_7$ crystallizes in the monoclinic system, space group C2/c, with the unit cell dimensions a = 17.140(5), b = 4.865[2], c = 5.548[2] A and $\beta = 91.0[1]°$. The structure was determined by Fourier methods and refined by several three-dimensional least-squares cycles to give a residual R, of 15.1 percent. It contains double layers formed by Ta-O octahedra sharing edges and corners, which are joined through the

five-coordinated tin atoms lying in interlayer positions. Structural relationships with other multiple oxides of Ta, Nb and Ti are discussed on the basis of their octahedral groupings. — Author's abstract

Munnich, Karl-Otto. *See* Roether, Wolfgang. 06402

06458 **Munson, R. C.** Relationship of effect of waterflooding of the Rangely Oil Field on seismicity, *in* Engineering seismology — The works of man: Geol. Soc. America Eng. Geology Case Histories, no. 8, p. 39-49, illus., table, 1970.

After 10 years of waterflooding of the Rangely Oil Field of Colorado, begun in December 1957 to recover the maximum amount of oil from the reservoir, fluid production still exceeds fluid injection. By October 1967 the deficit was 92 million barrels of fluid. A seismic study, using seismograms from the Uinta Basin Seismological Observatory, was made of the Rangely area. Epicenters of the earthquakes centered on the reservoir and extended beyond its limits. No prominent secondary area of activity was found. A study of the net fluid injected into the reservoir and the number of earthquakes that occurred disclosed no positive time correlation between these two parameters. — *from* Author's abstract

Murata, K. J. *See* Madsen, Beth M. 06182

Musich, Lillian. *See* Berggren, W. A. 06160

06153 **Muskatt, Herman Solomon.** Petrology and origin of the Clinton Group of east-central New York and its relationship to the Shawangunk Formation of southeastern New York [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 12, pt. 1, p. 5558B, 1970.

06374 **Myers, D. A.** Availability of ground water in western Cowlitz County, Washington: Washington Dept. Ecology Water-Supply Bull. 35, 63 p., illus., tables, geol. map, 1970.

Large towns use surface sources for minicipal water supply, but major industries and rural populations depend on ground water; from all sources, the county uses annually a total of 59 billion gallons. Wells produce water from Tertiary sedimentary and igneous rocks and Holocene alluvial materials; with depths of from less than 6 to more than 600 feet, well yields range from less than 1 to over 3,000 gpm; yields from alluvial aquifers vary with percentages of clay and silt. Wells near the Columbia River tap the most productive of alluvial aquifers; response of their water levels to river stage is almost immediate and of the same general magnitude as the range in the river's tidal stage. Ground-water use in some parts of the county is limited by its quality. Otherwise, chemical quality of the ground water is generally good. — *from* Author's abstract

06352 **Nagata, T.; Ishikawa, Y.; Kinoshita, H.; Kono, M.; Syono, Y.; Fisher, R. M.** Magnetic properties and natural remanent magnetization of lunar materials, *in* Apollo 11 Lunar Sci. Conf., Houston, Tex., 1970, Proc. — V. 3, Physical properties: New York, and Oxford, England, Pergamon Press (Geochim. et Cosmochim. Acta Supp. 1), p. 2325-2340, illus., tables, 1970.

The magnetic properties of lunar crystalline rocks are due to paramagnetism of pyroxenes, antiferromagnetism of ferrosilite and ilmenite, and ferromagnetism of native iron. Native iron is estimated magnetically to be about 0.08 weight percent of the rock. Paramagnetic and antiferromagnetic minerals in fines are similar to those in crystalline rock, but native iron is about 7.5 times more abundant due to admixture of iron micrometeorites. The very fine grain size of some of the metallic iron (10^2A order of magnitude) results in the superparamagnetic characteristics; this component of native iron causes marked viscous magnetization. Natural remanent magnetization of lunar rock is 7.5×10^{-4} emu per g in intensity and is stable against a-c demagnetization of less than 30 oe. A lunar microbreccia has a remanent magnetization, 1.53×10^{-4} emu per g, stable against a-c demagnetization up to 500 oe; this implies that some lunar materials are strongly and stably magnetized by some mechanism, presumably related to meteorite impacts. — DBV

06291 **Nash, D. B.; Greer, R. T.** Luminescence properties of Apollo 11 lunar samples and implications for solar-excited lunar luminescence, *in* Apollo 11 Lunar Sci. Conf., Houston, Tex., 1970, Proc. — V. 3, Physical properties: New York, and Oxford, England, Pergamon Press (Geochim. et Cosmochim. Acta Supp. 1), p. 2341-2350, illus., table, 1970.

Luminescence measurements of Tranquillity samples indicate that energy efficiencies for laboratory excitation by protons and ultraviolet radiation are in the range 10^{-6} or below; natural and induced thermoluminescence is even weaker. If these samples are typical, lunar surface luminescence cannot occur at reported levels. Comparison of proton luminescence spectra from the exterior and interior of rocks and fine fragments provides evidence of solar wind impingement on the Moon's surface. — Authors' abstract

05807 **Nassichuk, W. W.; Spinosa, Claude.** *Helicoprion* sp., a Permian elasmobranch from Ellesmere Island, Canadian Arctic: Jour. Paleontology, v. 44, no. 6, p. 1130-1132, illus., 1970.

Helicoprion has previously been found in the Canadian Arctic Archipelago only in the upper Lower Permian Assistance Formation on Sabine Peninsula, Melville Island. Two additional specimens are now known from a coeval unnamed formation mainly black siltstone and chert at Blind Fiord, southwestern Ellesmere Island. — *from* Authors' abstract

Nation, J. B. *See* Hales, A. L. 05796

06388 **Navrotsky, A.; Muan, A.** Phase equilibria and thermodynamic properties of solid solutions in the systems $ZnO\text{-}CoO\text{-}TiO_2$ and $ZnO\text{-}NiO\text{-}TiO_2$ at 1050°C: Jour. Inorganic and Nuclear Chemistry, v. 32, no. 11, p. 3471-3484, illus., tables, 1970.

Phase equilibria and conjugation lines were determined in the systems $ZnO\text{-}CoO\text{-}TiO_2$ and $ZnO\text{-}NiO\text{-}TiO_2$ at 1050°C. The free energies of formation of compounds in this system are, in kcal/mole: $CoTiO_3$, -3.6 ± 0.3; $NiTiO_3$, -2.6 ± 0.3; ($ZnTiO_3$, $+1.7 \pm 2.0$); Co_2TiO_4, -5.0 ± 0.4; (Ni_2TiO_4, -1.7 ± 1.0); Zn_2TiO_4, -4.7 ± 0.6. The spinel solid solution in the system $ZnO\text{-}CoO\text{-}TiO_2$ shows marked positive deviation from ideality, and the spinel solid solution in the system $ZnO\text{-}NiO\text{-}TiO_2$ shows positive deviation from ideality in the Zn-rich part and negative deviation from ideality in the NiO-rich part of the solid solution. — Authors' abstract

06453 **Naylor, R. S.; Steiger, R. H.; Wasserburg, G. J.** U-Th-Pb and Rb-Sr systematics in 2700×10^6-year old plutons from the southern Wind River Range, Wyoming: Geochim. et Cosmochim. Acta, v. 34, no. 11, p. 1133-1159, illus., tables, 1970.

To distinguish between episodic and continuous-diffusion loss mechanisms, and to compare the response of different parent-daughter systems to metamorphism, we have studied a series of well-exposed plutons, all about 2700 m.y. old and showing different degrees of metamorphism. The Louis Lake granodiorite pluton in the southern Wind River Range, Wyo., represents granitic rocks only slightly affected by later disturbances. Rb-Sr data on total-rock samples indicate that the pluton was emplaced 2630 ± 20 m.y. ago with an initial Sr-87/Sr-86 ratio of 0.702 ± 0.001. Data on cogenetic zircon fractions show that if the zircons reflect Laramide disturbance, this is not detected by the Rb-Sr data on mineral separates. Disturbance of these data is readily apparent only in rocks with high Rb/Sr ratios and has yielded no apparent secondary ages younger than 2000 m.y. — *from* Authors' abstract

Neathery, Thornton L. *See* Bentley, Robert D. 06059

06225 **Nelson, Katherine G.; Lasca, Norman P.** Milwaukee, its geologic setting: Geotimes, v. 17, no. 8, p. 12-18, illus., 1970.

Milwaukee, site of the Geological Society of America 1970 meetings, offers a setting on Lake Michigan, Pleistocene glacial topography, Paleozoic exposures, and variable character and thickness of surficial deposits creating erosion and foundation problems. The wide Menomonee Valley was once a glacial spillway. Bedrock is

masked by glacial, fluvial, and lacustrine deposits, but the underlying rocks determined movement of Pleistocene ice. Beds dip east and southeast, and erosion has formed a series of north-south ridges. The Wisconsin ice sheet divided into the Lake Michigan and Green Bay lobes as it crossed the Niagara escarpment; large quantities of drift were deposited. Thickness of Pleistocene sediments in the Milwaukee area ranges from a few inches to 400 feet, causing foundation problems. Principal aquifers are Cambrian-Ordovician beds, Niagara Dolomite, and Pleistocene sands and gravels. — ESL

06117 **Nelson, Robert S.; Semken, Holmes A.** Paleoecological and stratigraphic significance of the muskrat in Pleistocene deposits: Geol. Soc. America Bull., v. 81, no. 12, p. 3733-3737, illus., 1970.

The muskrat (*Ondatra* spp.), common in late Kansan and post-Kansan deposits, provides a stratigraphic tool for deposits of glacial age, but specimens of interglacial age appear out of sequence in the regression. The nearly ubiquitous distribution in North America of modern muskrats has precluded paleoecological interpretations other than for the presence of permanent water. Fossil molars reveal that specimens from deposits interglacial in age have a significantly lower length/width ratio than those from glacial age deposits. Statistical examination of 403 recent first-lower molars indicates that both *O. zibethicus zibethicus* and *O. z. cinnamonius* in southern regions show significantly lower length/width tooth ratio than those in northern regions. Thus the data suggest that this ratio seems to be a reliable tool in distinguishing between "warm" and "cool" members. — *from* Authors' abstract

05961 **Neuschel, Sherman K.** Correlation of aeromagnetics and aeroradioactivity with lithology in the Spotsylvania area, Virginia: Geol. Soc. America Bull., v. 81, no. 12, p. 3575-3582, illus., 1970.

A detailed aeromagnetic and aeroradioactivity survey made in the Spotsylvania area of eastern Virginia was field checked and compared with lithologic map. Correlation is reported as excellent between geophysical data and lithologic units. Radioactive highs are generally associated with magnetic lows and in areas of flat magnetic expression radioactivity detail is considerable. The two maps used in conjunction with field mapping are aids in filling in geology between widely spaced outcrops. — *from* Author's abstract

06378 **Newcomb, R. C.** Tectonic structure of the main part of the basalt of the Columbia River Group, Washington, Oregon, and Idaho: U.S. Geol. Survey Misc. Geol. Inv. Map 587, scale 1:500,000, text, 1970.

The map, compiled from various data sources and supplemented by field reconnaissance, shows areas in which geologic structure favors accumulation and storage of ground water in the Miocene-Pliocene Columbia River Basalt. The structures that displace the basalt are Pliocene and Quaternary; most anticlines are tectonic mountains, and synclines are tectonic valleys. Folds are both smoothly symmetrical and greatly asymmetrical. Most of the long, prominent faults are normal and dip 60-85°; a few high-angle reverse faults have been identified and low-angle thrust faults are common locally in and near limbs of some anticlines. Vertical displacement of basalt in the folds ranges from about 100-3,000 feet; displacement on faults ranges from 50-3,000 feet. — MCM

06250 **Nielsen, Bjarne Leth.** Preliminary report on the core drillings in the radioactive rocks of Kvanefjeld in the Ilímaussaq intrusion, *in* Report of activities, 1969: Grönlands Geol. Undersögelse Rap. 28, p. 33-35, 1970.

Here, in extensive intrusion breccia, lujavrite forms the matrix in which older intrusives and supracrustals form blocks of various sizes; patterns are complicated by tectonic disturbances, dike intrusions, and late hydrothermal activity. Radioactivity is most concentrated where lujavrite is in contact with lava roofs. U mineralization is in NE-SW-striking deformation zones. Of scattered localities of radioactive rocks, the largest is near a central mine area, one other of economic interest is on northwestern edge of the plateau, and another to the north near a pegmatite in the boundary

between the intrusion and lavas. Seven holes were drilled 36 m to 450 m deep, to determine relations of U- and Th-bearing rocks. Estimated U tonnage, formerly calculated in mine area to be 4,000 tons, is increased by possible continuation to the northwest and also west of the narrow northeastern zone of deformed gabbro dikes and lavas. — GDC

Niskin, S. *See* Ostlund, H. Gote. 06467

Nissenbaum, A. *See* Brown, Frederick S. 06073

05819 **Nitecki, Matthew H.; Golden, Julia.** Catalogue of type specimens of trilobites in Field Museum of Natural History: Fieldiana—Geology, v. 22, 117 p., 1970.

Only holotypes are recognized as valid types; all other so-called types are listed as referred specimens. Entries are listed in their original form and are arranged alphabetically by genera, and within each genus alphabetically by species. Stratigraphic positions, geographic data, and catalog numbers are listed as they appear in the Field Museum files; sources of specimens and names of collectors or collections are given for most specimens. — *from* Authors' introduction

06227 **Nitecki, Matthew H.** North American cyclocrinitid algae: Fieldiana — Geology, v. 21, 182 p., illus., tables, 1970.

Cyclocriniteae are here classified as a tribe of Middle Ordovician to Middle Silurian marine dasycladaceous algae of primitive receptaculitid stock, with skeletal elements consisting of a seldom calcified main axis on which lateral branches are borne in whorls. This is the first monograph on North American cyclocrinitids; they are represented by three genera: *Anomaloides* (one species), with calcified laterals ending in branching secondary laterals; *Cyclocrinites* (7 species and extensive synonymy), with globose thallus and laterals ending in six-sided heads; *Lepidolites* (one species), with short, small calcified laterals ending in overlapping plates. *Cyclocrinites welleri* n.sp. is described from the Mazourka Formation, Middle Ordovician, California. Morphology, degree of preservation, and paleoecology are interpreted in comparison with modern Dasycladaceae. — VMJ

06164 **Noble, Donald C.; McKee, Edwin H.; Smith, James G.; Korringa, Marjorie K.** Stratigraphy and geochronology of Miocene volcanic rocks in northwestern Nevada, *in* Geological Survey research 1970, Chap. D: U.S. Geol. Survey Prof. Paper 700-D, p. D23-D32, illus., tables, 1970.

A thick succession of ash-flow and air-fall tuff and mafic, intermediate, and silicic lavas in western Humboldt and northern Washoe Counties, Nev., has been subdivided, using widespread ash-flow sheets, four of which are named herein, as key stratigraphic markers. The approximate original areal extent and definite or probable source areas have been determined for many of the ash-flow sheets. Potassium-argon age determinations show that most of the volcanic rocks were erupted between 14.5 and 16 million years ago, but that the lowest ash-flow unit described in this paper is about 24 million years old. These ages indicate a Miocene age for the volcanism. — Author's abstract

05859 **Noda, Edward.** Water waves generated by landslides: Am. Soc. Civil Engineers Proc., v. 96, paper 7699, Jour. Waterways, Harbors and Coastal Eng. Div., no. WW4, p. 835-855, illus., tables, 1970.

The problem of water waves generated by landslides is studied by considering two distinct types of landslide: vertical, modeled by a two-dimensional box falling vertically; and horizontal, which enters and moves through the water horizontally, modeled analytically by a two-dimensional wall which moves into a fluid domain. Theoretical solutions are obtained assuming that geometric and dynamic parameters of the problem are known. Graphs are presented for motion with constant velocity. For the vertical landslide problem, experimental results compare favorably in the region where linearized theory is valid. An approximate method is developed to find the amplitude of the largest wave in the nonlinear region by utilizing solutions ob-

tained from linear theory for vertical landslides. This approximate method is then applied to the Lituya Bay, Alaska landslide of July 9, 1958 to estimate the largest wave. — *from* ASCE abstract

05872 **Normark, William R.** Growth patterns of deep-sea fans: Am. Assoc. Petroleum Geologists Bull., v. 54, no. 11, p. 2170-2195, illus., tables, 1970.

Mapping of the La Jolla and San Lucas deep-sea fans with a deep-towed instrument package details the morphology, structure, and fill of the fan-valleys and suggests a model of fan growth. The model predicts that deposition on a fan will be localized in a suprafan at the end of large leveed valleys in the upper reaches of deep-sea fans. The suprafan, normally on the midfan, is characterized by numerous smaller distributary channels. Rapid aggradation in the suprafan and migration of channels produces a surface marked by isolated depression and channel remnants. Uniform deposition, producing a symmetrical half-cone morphology, results from the shifting through time of fan-valleys across the fan. — *from* Author's abstract

06189 **Norris, Stanley E.** The effect of stream discharge on streambed leakage to a glacial outwash aquifer, *in* Geological Survey research 1970, Chap. D: U.S. Geol. Survey Prof. Paper 700-D, p. D262-D265, illus., table, 1970.

Five controlled pumping tests of a glacial outwash aquifer, made in a comparatively small area in the Scioto River valley near Piketon, Ohio, showed ranges in aquifer transmissivity from 165,000 to 300,000 gallons per day per foot and in the rate of streambed leakage from 0.21 to 1.15 million gallons per day per acre for each foot of head difference between the stream and the underlying aquifer. The rate of streambed leakage varies with stream discharge and velocity, suggesting that higher flows progressively clean the streambed and increase its permeability. The relation of discharge to streambed leakage is important not only in the design of local groundwater supply facilities, but also because it may be applicable to a large part of the watercourse aquifer system in the lower Scioto River valley. — Autthor's abstract

Norton, P. R. *See* Morrison, J. A. 06262

Novak, G. A. *See* Brown, G. E. 06074

Nutalaya, Prinya. *See* Braddock, William A. 06415

06384 **Ocean Industry.** Nuclear probe for underwater detection of minerals: Ocean Industry, v. 5, no. 10, p. 39-40, illus., 1970.

A recently developed nuclear probe is described which can detect minerals on the sea floor; it can be operated from a surface ship or from a submersible vehicle. The probe consists of 0.2 mg of Cf-252 and a germanium-lithium gamma-ray detector. The Cf-252 source emits a low flux of neutrons which are absorbed by the minerals being measured; subsequent decay of the C-252 leads to emission of delayed gamma-rays. The detector measures the gamma rays which permits scientists to determine the elemental contents of the minerals. The source is in a sealed stainless steel cylinder, about 0.5 in. in diameter and 3 in. long, at one end of the probe; the detector, 2 × 2 in. in diameter, is at the other end of the probe. — VSN

05948 **O'Connell, Daniel T.** Memorial of Bertram Theodore Butler — March 22, 1874-October 5, 1958: Am. Mineralogist, v. 55, nos. 3-4, p. 551-554, portrait, 1970.

Offield, T. W. *See* Rowan, L. C. 05960

06263 **O'Keefe, John A.** The origin of the Moon: Jour. Geophys. Research, v. 75, no. 32, p. 6565-6574, illus., 1970.

Examination of Apollo 11 samples supports a previously constructed theory of the origin of the Moon based on the chemical analysis of tektites. It is suggested that the parent body of Earth and Moon was a large planet with a deep envelope of light gases surrounding a silicate shell and having a metallic core. Formation of the core im-

poverished the silicates in siderophile elements. The planet was initially hot and the gases escaped. Rotation was rapid, and an increase in angular velocity led eventually to fission. The fission process left a proto-Moon with one-tenth or more of the mass of the proto-Earth. The two bodies raised very large tides in each other, and each lost substantial mass (the Moon about 90 percent of its initial mass). Losses of volatiles were naturally disproportionately large. Thus the observed deficiencies of volatile and siderophile elements in the Moon are explained. — DBV

05883 **Okuma, Angelo.** Geology of the carbonate rocks of Path Valley, Franklin County, Pennsylvania: Pennsylvania Geol. Survey Prog. Rept. 179, 1 sheet, scale 1:62,500, sections, text, 1970.

Bedrock exposed in the Path Valley area ranges from Ordovician Beekmantown Group to Lower Silurian Tuscarora Formation, with a total stratigraphic thickness of about 4,500 feet divided into nine formations, composed of limestone, dolomite, shale, sandstone, and quartzite with minor amounts of siltstone and chert. Major structure is a roughly symmetrical, doubly plunging anticline, with subsidiary folds on its flanks. Two mapped faults are the Path Valley and Fennettsburg faults. It is postulated that tectonic history consists of a period of gentle folding, followed by a period of continued folding accompanied by thrust faulting along the steeper flank of the asymmetrical anticline. Several of the carbonate rocks have economic potential. — MCM

O'Leary, B. T. *See* Gold, T. 06278

06259 **O'Leary, Brian; Briggs, Frank.** Optical properties of Apollo 11 Moon samples: Jour. Geophys. Research, v. 75, no. 32, p. 6532-6538, illus., table, 1970.

Lunar powder samples returned by Apollo 11 are remarkably similar in their optical properties to those measured for an area of several square kilometers surrounding Tranquillity Base, suggesting a ubiquitous covering of the same material in the region. However, there are minor exceptions to the close match: the powder sample shows large polarizations and a larger opposition effect than would be expected from previous observations. In the spectrum of the lunar rock samples, we detected a strong, broad absorption at 0.92μ and a weaker band at $> 1.8\mu$, which are likely to be caused by Fe^{2+} in clinopyroxene. The band near one micron was absent in the powder sample (presumably because the particle sizes were too small), which suggests that the spectrophotometer may become a valuable tool in distinguishing between rocky and dusty areas on the Moon. — Authors' abstract

Olivet, Jean-Louis. *See* Auzende, Jean-Marie. 06446

06412 **Olsen, C. W.** Soil strain near a nuclear detonation: Seismol. Soc. America Bull., v. 60, no. 6, p. 1999-2014, illus., tables, 1970.

Radial and transverse strain seismometers using 6.1-m Invar rods were installed 457, 914, and 1524 m from ground zero on a nuclear detonation at the Nevada Test Site. The detonation, Hutch, took place in alluvium at a depth of 548 m and gave a body-wave magnitude of 5.4 ± 0.2. Dynamic and quasi-static strain data were recorded along with triaxial accelerations at the 914-m location. The dynamic data show large strains (2×10^{-3}) and a considerable shear-wave activity related to the subsurface structure. Decay with range, corrected for the inelastic region, shows dependence of peak amplitudes of about R^{-3}, but influence of the alluvium is present. The quasi-static data show large strain steps ($> 10^{-4}$) at the two nearer stations and considerable dependence on alluvium depth. The strain decay with time is not consistent with that observed on Benham, and, at 914 m, appears to be a permanent step, similar to that observed on the Jorum event. — Author's abstract

Olsen, Saki. *See* Crowley, William. 05829

Oostdam, B. L. *See* Sheridan, R. E. 05792

O'Reilly, W. *See* Runcorn, S. K. 06292

06414 **Osterwald, Frank W.** Comments on rock bursts, outbursts, and earthquake prediction: Seismol. Soc. America Bull., v. 60, no. 6, p. 2083-2085, 1970.

The paper under discussion was published in ibid., v. 59, no. 3, p. 1259-1280, 1969; Abs. North American Geology, January 1970.

Ostlund, H. Gote. *See* Roether, Wolfgang. 06402

Carbon-14 values are reported on total dissolved carbon in a profile from the surface to 4,000 meters in the Pacific Ocean, off California, in September 1969. Bomb-produced C-14 is evident in surface layers, whereas below 1,000 meters ΔC-14 values are around -225 per mil. — Authors' abstract

06467 **Östlund, H. Göte; Niskin, S.** Radiocarbon profile in the North Pacific 1969 Geosecs intercalibration station: Jour. Geophys. Research, v. 75, no. 36, p. 7667, table, 1970.

05972 **Otvos, Ervin G., Jr.** Development and migration of barrier islands, northern Gulf of Mexico — Reply [to discussion by J. H. Hoyt of 1970 paper]: Geol. Soc. America Bull., v. 81, no. 12, p. 3783-3788, illus., 1970.

For the paper under discussion, *see* ibid., v. 81, no. 1, p. 241-246, 1970; Abs. North American Geology, June 1970. Discussion by Hoyt, ibid., v. 81, no. 12, p. 3779-3782, 1970.

06180 **Overstreet, William C.; White, Amos M.; Warr, Jesse J., Jr.** Uranium-rich monazites in the United States, *in* Geological Survey research 1970, Chap. D: U.S. Geol. Survey Prof. Paper 700-D, p. D169-D175, illus., tables, 1970.

Uranium-rich monazites in the United States, defined as being 0.95 percent or more U_3O_8, have thus far been found only in parts of the Inner Piedmont province of North and South Carolina. Principal sources of these monazites are granitic rocks and pegmatites that range in age from Ordovician to Permian. A post-tectonic quartz monzonite of Mississippian(,) to Permian(,) age is the source of the most uranium-rich monazite — 2.34 percent U_3O_8 — yet reported from the United States. Analyzed monazites from North and South Carolina, derived chiefly from stream placers, cannot be related positively to their source rocks. A thorough investigation of the geologic factors that influence distribution of uranium-rich monazite, therefore, will require collection and study of monazite from specific rock units. — *from* Authors' abstract

06184 **Overstreet, William C.; Warr, Jesse J., Jr.; White, Amos M.** Influence of grain size on percentages of ThO_2 and U_3O_8 in detrital monazite from North Carolina and South Carolina, *in* Geological Survey research 1970, Chap. D: U.S. Geol. Survey Prof. Paper 700-D, p. D207-D216, illus., tables, 1970.

Chemical analyses for ThO_2 and U_3O_8 content in 81 sized fractions of detrital monazite from 33 drainage basins in North and South Carolina disclosed a strong tendency for percentage of ThO_2 to vary with particle sizes of monazite at each locality. Higher percentages of ThO_2 are associated with coarse-grained monazite, a relation thought to result from the tendency of certain grain-size ranges of detrital monazite to be associated with monazite from specific rock units. The role of size in relation to tenor of U_3O_8 was not fully brought out; differences in percentage were greater than those attributed to analytical procedure, and more analyses are required to define trends. A tendency to select coarse detrital grains of monazite can introduce bias in reported tenor in ThO_2. Knowledge that composition of a detrital mineral may vary with grain size and that grain-size distribution varies by rock type might be used in geochemical exploration. — *from* Authors' abstract

06139 **Ovnatanov, S. T.; Tamrazyan, G. P.** Reply [to discussion by T. A. Jones of "Paleostructure and lithologic variation coefficients, their use in exploration for new oil and gas pools," 1969]: Am. Assoc. Petroleum Geologists Bull., v. 54, no. 9, p. 1750-1752, 1970.

The properties of the coefficients "L" and "f" primarily are used to make comparative analyses of different, adjacent horizons. Jones' discussion demonstrates the use of "L" for revealing lithic change within a horizon which should be demonstrated by sandstone percentage maps, thickness maps, etc. The proper usage of the coefficients is shown with a hypothetical sandstone isopach map and 16 well localities. *See* ibid., v. 53, no. 10, pt. 1, p. 2171-2178, 1969; Abs. North American Geology, March 1970. — SEF

05860 **Owens, James P.; Minard, James P.; Sohl, Norman F.; Mello, James F.** Stratigraphy of the outcropping post-Magothy Upper Cretaceous formations in southern New Jersey and northern Delmarva Peninsula, Delaware and Maryland: U.S. Geol. Survey Prof. Paper 674, 60 p., illus., tables, 1970.

Stratigraphic studies of post-Magothy Upper Cretaceous Coastal Plain formations of Delmarva Peninsula indicate that four of the formations recognized in New Jersey are present in northern Delaware and eastern Maryland — Merchantville, Englishtown, and Marshalltown Formations and Mount Laurel Sand; the Wenonah and Navesink Formations probably either pinch out or have been eroded away between southern New Jersey and northern Delaware. Each formation shows a depletion of glauconite sand toward the southwest. Comparison of faunas confirms the rock stratigraphic correlations. The megainvertebrate fossils have proved to be more useful than microfauna in stratigraphic correlation. The *Exogyra cancellata* zone in Mount Laurel Sand and the *E. ponderosa* zone in Marshalltown Formation are in the same stratigraphic positions in southern New Jersey and in the Delmarva Peninsula. — JPO

Owens, James P. *See* Sirkin, Leslie A. 06170

Oxburgh, E. R. *See* Turcotte, D. L. 06261

06021 **Palmer, Arthur Nicholas.** A hydrologic study of the Indiana karst — An evaluation of the effects of geologic setting upon ground-water flow and water supply in a karst region, with special reference to northwestern Lawrence County, Indiana [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 12, pt. 1, p. 5578B, 1970.

06306 **Palmer, Dennis E.** Geology of Stansbury Island, Tooele County, Utah: Brigham Young Univ. Geology Studies, v. 17, pt. 2, p. 3-30, illus., geol. map, 1970.

Stansbury Island, a north-south block-faulted range about 33 mi west of Salt Lake City, extends into the southern end of Great Salt Lake. Exposed sedimentary rocks are about 11,000 feet thick, and range in age from Precambrian to Mississippian. Paleozoic rocks on the island underwent gentle Laramide folding followed by later Laramide thrusting so that Stansbury anticline was sheared and thrust a minimum horizontal distance of three mi to the east. Early Basin and Range normal faulting followed, and was in turn followed by east-west strike-slip faults, and smaller east-west, northwest transverse normal faulting. Two large east-west strike-slip faults separate the island into three structurally distinct blocks, the central block moving westward relative to the southern and northern. Late Basin and Range faulting raised the island to its present position. — *from* Author's abstract

06005 **Palmer, Harold Dean.** Wave-induced scour around natural and artificial objects [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 12, pt. 1, p. 5558B, 1970.

Palonen, P. *See* Card, K. D. 06420

Palonen, P. *See* Card, K. D. 06421

Palonen, P. *See* Card, K. D. 06422

05992 **Park, Robert Gene.** The electrophoretic separation of mixtures of pure clays and the electrophoretic separation and characterization of a soil allophane [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 12, pt. 1, p. 5326B, 1970.

06341 **Parkash, Barham; Middleton, Gerard V.** Downcurrent textural changes in Ordovician turbidite graywackes: Sedimentology, v. 14, nos. 3-4, p. 259-293, illus., tables, 1970.

Longitudinal and vertical variation in grain orientation and size has been studied in eight turbidite graywacke beds in the Cloridorme Formation exposed on a wave-cut platform, Gaspé, Quebec. The grain fabric is primary in nature and grains are typically aligned parallel to current direction over a two-mile area. Orientations are nonsignificant in the upper massive parts of the beds in the proximal region, and significant in the rest of the beds. Grain orientations are increasingly divergent from the base towards the top of the bed. The beds show good grading in the proximal area, and are ungraded or slightly reverse graded in the distal area; these characteristics are exhibited by both mean and maximum grain size. Most beds show no appreciable variation in the mean grain size at the base of the bed along the strike. — *from* Authors' summary

Parrott, B. S. *See* Bernard, Hugh A. 05896

Parrott, B. S. *See* Bernard, Hugh A. 05897

06398 **Pastine, D. John.** On the accuracy of the Wachtman-Anderson relation: Jour. Geophys. Research, v. 75, no. 35, p. 7421-7425, 1970.

The Wachtman-Anderson relation has consistently shown itself to be an accurate interpolation equation for the experimental isobaric relationship between the isentropic bulk (B_s) or Young's (Y_s) modulus and the temperature T. Here the equation is analyzed in some detail, and it is shown that, although the equation is an approximation, a high degree of consistency is maintained between the relation itself and the Grüneisen equations from which it has been derived. In particular it is shown that the relation may be used to obtain reasonable estimates of the derivative $(\delta^2 B_s/\delta T^2)$ along the zero-pressure isobar. — Author's abstract

05930 **Paterson, M. S.; Turner, F. J.** Experimental deformation of constrained crystals of calcite in extension [with German abs.], *in* Experimental and natural rock deformation — Internat. Symposium, Darmstadt, Germany, 1969, Proc. (P. Paulitsch, editor): Berlin and Heidelberg, Germany, Springer-Verlag, p. 109-141, illus., tables, 1970.

Calcite crystals were enclosed in strong metal jackets to introduce constraints additional to those normally present in tests on single crystals. Composite specimens were elongated by various amounts under confining pressure of 5 kb at 300°C. A detailed microscopic study was made of effects of the constraints on mechanisms of deformation and patterns of distribution of strain within crystals. Two main effects were evident: First, domains of heterogeneous deformation on the scale of the crystal, such as kinks, were no longer sharply defined; second, there was a tendency for glide to occur on more than one plane. The work has relevance to problems of deformation of mineral grains in rocks since boundary conditions employed approach realistically those imposed on a crystal in aggregate under metamorphic conditions. — *from* Authors' abstract

Patterson, James H. *See* Economou, Thanasis E. 06258

Patterson, O. F., 3d. *See* Hope, R. C. 05809

Pearce, G. W. *See* Strangway, D. W. 06297

06166 **Pease, Maurice H., Jr.** Pleistocene stratigraphy observed in a pipeline trench in east-central Connecticut and its bearing on the two-till problem, *in* Geological Survey research 1970, Chap. D: U.S. Geol. Survey Prof. Paper 700-D, p. D36-D48, illus., 1970.

Four lithostratigraphic units were exposed in a 17-mi-long pipeline trench in east-central Connecticut during 1966: bedrock is generally overlain by till in uplands and glaciofluvial deposits in valleys; lower till is oxidized, olive brown, and compact;

upper till is less oxidized, olive gray, and friable; glaciofluvial deposits are crudely stratified gravel and sand having few fine-grained constituents. At many New England localities presence of an oxidation profile up to 40 feet deep beneath an unoxidized till and occurrence of contorted and truncated structures in underlying till indicate an older till probably was deposited during an early ice advance and overridden by a later ice sheet. Two ice advances were not apparent in the trench, but lower and upper tills have been correlated with older and younger tills on a basis of lithology, texture, and stratigraphic position. — *from* Author's abstract

06243 **Pedersen, K. Raunsgaard.** Late Precambrian microfossils from Peary Land, *in* Report of activities, 1969: Grönlands Geol. Undersögelse Rap. 28, p. 16-17, 1970.

Black chert from late Precambrian (Eocambrian) dolomite of Jorgen Brönlunds Fjord area in southern Peary Land, Greenland, contains several types of microfossils similar to a flora of the same age from Australia. The dolomite series lies between the Cambrian Brönlunds Fjord dolomite and a tillite, at the base of which is the Eocambrian boundary; discordant sills in the underlying Precambrian were recently dated at about 1,000 m.y. In the chert a 3-cm-thick layer has abundant, flat elliptical ooliths, up to 3 mm in diameter; between ooliths, and concentrated within their outer part, are the microfossils. One very abundant type, with an affinity to the genus *Eomycetopsis*, consists of unbranched tubes of about 4 micron diameter and 400 micron length, in dense clusters or single. Another type, globular with diameter of 120 micron, is related to colonies of the genus *Myxococcoides*. — GDC

05826 **Pennsylvania Geologists.** New interpretations of eastern Piedmont geology of Maryland, *or* granite and gabbro or graywacke or greenstone? — 35th Ann. Field Conf., 1970, Guidebook: Harrisburg, Pa., Pennsylvania Topog. and Geol. Survey, *also* Baltimore, Md., Maryland Geol. Survey, 60 p., illus., 1970.

This guidebook to areas in Cecil, Harford, and Baltimore Counties, deals with classical sections of Precambrian and Lower Paleozoic? rocks in the eastern Piedmont of Maryland. Separately cited are the introduction by William Crowley, and field-trip introductions and road logs, for the first day by Michael Higgins and Crowley, and for the second day by Crowley and Saki Olsen. Comments on archeology by Tyler Bastian, the first day, are not cited separately. A generalized geologic map of Maryland indicates most important mineral products of the various units. Among the figures are geologic sketch maps of Cecil County and quarries in Baltimore gneiss dome, and diagrams to show nature of the Port Deposit pluton. A table in the first day's road log gives chemical analyses of gabbros and basalts from Cecil County. — GDC

06254 **Perch-Nielsen, K.** Field mapping in Palaeozoic and Mesozoic sediments of Jameson Land, Scoresby Land and Werner Bjerge, *in* Report of activities, 1969: Grönlands Geol. Undersögelse Rap. 28, p. 42-43, 1970.

In this second year of the Scoresby Sund project, three field parties spent six weeks in the northern part: one mapped the flat land southwest of Ölympen; one completed the map of southwestern Scoresby Land; the third mapped in the Werner Bjerge a Tertiary massif and in northwestern Jameson Land. The areal distribution of various lithostratigraphic units is described. Paleozoics, exposed only at east and west borders of the Jameson Land basin, in central part are covered by Triassic and Jurassic deposits; Carboniferous rocks are faulted down against crystallines at west border; Upper Permian conglomerates, transgressing over Devonian sandstones at east border, are overlain on both sides of basin by reef limestones, covered in turn by Triassic marine and continental sediments. Trace fossils of the Middle Jurassic "Yellow Series" indicate shallow marine and delta deposits. Dikes and sills are found near Örsted Dal. — GDC

Perch-Nielsen, Katharina. *See* Berggren, W. A. 06160

06105 **Perrault, Guy.** (editor). Alkaline rocks, the Monteregian Hills — Symposium, Joint Ann. Mtg., Mineralog. Assoc. Canada, Geol. Assoc. Canada, Mineralog. Soc. America, Montreal, 1969, Proc.: Canadian Mineralogist, v. 10, pt. 3, p. 295-598, illus., tables, 1970.

The final organization of this symposium and of the papers in it center around three objectives: focusing attention on field data for important alkaline rock occurrences, especially agpaitic, resembling the Monteregian Hills; reviewing latest activity in experimental petrology as applied to genesis of alkaline rocks; and bringing together the most recent laboratory and field data on the Monteregian Hills. The symposium contains 18 papers, all but one of which are cited separately. — ESL

Perry, T. G. *See* Corneliussen, Eric F. 05870

05850 **Persinger, Ival D.; Yahner, Joseph E.** Relation of percolation rates to soil texture on several Indiana soils: Jour. Soil and Water Conserv., v. 25, no. 5, p. 189-191, illus., tables, 1970.

A study was conducted in St. Joseph County, Indiana, to determine the relationship between percolation rate and soil texture. Forty sites were selected on nine soil series and relationships developed by regression analysis. A highly significant correlation was obtained on these glacial outwash, glacial till, and lacustrine soils [between percolation rates and sand content between 28 and 44 inches deep]. The study determined that planning groups could use soil texture inferred from soil maps as a substitute for percolation rates. [For the soils studied in St. Joseph County, four percolation groups are all that can be justified, based on variability of the data; soil maps are valuable planning tool for subdivision development, especially as they relate to onsite sewage disposal.] — Authors' abstract and conclusions

Pessagno, Emile A., Jr. *See* Powell, J. Dan. 06030

06417 **Pessl, Fred, Jr.** Surficial geologic map of the Woodbury quadrangle, Litchfield and New Haven Counties, Connecticut: U.S. Geol. Survey Geol. Quad. Map GQ-896, scale 1:24,000, sections, text, 1970.

The Woodbury quadrangle is underlain by pre-Triassic crystalline rocks, except in the Pomperaug Valley which is underlain by Triassic sedimentary and volcanic rocks. No evidence of early Pleistocene glaciation is recognized, and all glacial deposits mapped and described are believed to be of Wisconsin age. The principal direction of glacier flow was from northwest to southeast; till fabric data suggest ice movement direction from north to northeast. The most valuable natural resource is sand and gravel from the stratified drift. — MCM

Peterman, Zell E. *See* Lee, Donald E. 06209

Petersen, G. W. *See* Chiang, S. L. 06389

06006 **Peterson, Fred.** Cretaceous sedimentation and tectonism in the southeastern Kaiparowits region, Utah [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 12, pt. 1, p. 5559B, 1970.

06167 **Peterson, Warren L.; Kepferle, Roy C.** Deltaic deposits of the Borden Formation in central Kentucky, *in* Geological Survey research 1970, Chap. D: U.S. Geol. Survey Prof. Paper 700-D, p. D49-D54, illus., 1970.

The Borden Formation (Lower Mississippian) in central Kentucky is a deltaic deposit consisting of three main sedimentary units — the Muldraugh Member and the underlying shale member which has two parts. The top of the shale member preserves a relatively steep SW-facing, NW-trending slope, interpreted to be an ancient delta front. To the northwest, the front, continuous with a front on Borden deltaic sediments in the Indiana and Illinois subsurface, continues southeastward to a few miles southeast of Campbellsville, Ky.; beyond, it probably coincides with a southeasterly trending line of lithologic change across which the carbonate-poor Borden Formation passes laterally southwestward into the stratigraphically equivalent, and carbonate-rich, Fort Payne Formation. — *from* Authors' abstract

05967 **Philbrick, Shaller S.** Horizontal configuration and the rate of erosion of Niagara Falls: Geol. Soc. America Bull., v. 81, no. 12, p. 3723-3731, illus., 1970.

The rate of regression of Horseshoe Falls in the Upper Great Gorge appears to have been quite variable. Comparison of surveys from 1842 to 1966 shows the recession rates are faster when the Horseshoe has a well-defined horizontal notch in its crest and slower when the crest is in the form of a horizontal arch. Corroborating evidence comes from soundings in the Maid of the Mist Pool that show a series of basins (plunge pools) whose positions correlate with the arch-shaped crests. Photoelastic comparison of notched and arched crests show that stresses in a notched crest are about 3X those in an arched crest, and a much greater amount of fracturing in the rock adjacent to a relict notched crest near Prospect Point substantiates this interpretation. — EHP

05799 **Phillips, J. D.** Reply [to discussion by H. A. Meyerhoff of "Continental Rise off North America" by K. O. Emery, E. Uchupi, J. D. Phillips, and others, 1970]: Am. Assoc. Petroleum Geologists Bull., v. 54, no. 11, p. 2215, 1970.

The original paper was published *in* ibid., v. 54, no. 1, p. 44-108, 1970; *see* Abs. North American Geology, July 1970.

06110 **Philpotts, A. R.** Mechanism of emplacement of the Monteregian intrusions, *in* Alkaline rocks, the Monteregian Hills — Symposium, Montreal, 1969, Proc.: Canadian Mineralogist, v. 10, pt. 3, p. 395-410, illus., table, 1970.

Although there was considerable explosive activity in the western end of the Monteregian province, most basic rocks of the main intrusions were emplaced in a passive manner. These intrusions form vertical plug-like bodies in which there is usually a steeply dipping igneous foliation parallel to the contacts. Flat lying sedimentary rocks around the intrusions were neither domed up, nor punched up by the magma. Instead, room for the intrusions was provided by the partial fusion and stoping of the country rocks, evidence of which can be found in the contact zones. Basic rocks of the intrusions were emplaced as plug-like bodies of convecting magma that brought up necessary heat to continue the partial fusion and stoping process. Some of the partially fused sedimentary rocks were assimilated by the basic magma; some may have been transported to depth and later intruded to form bodies of oversaturated rocks. — *from* Author's abstract

06108 **Philpotts, John A.; Schnetzler, C. C.** Speculations on the genesis of alkaline and sub-alkaline basalts following exodus of the continental crust, *in* Alkaline rocks, the Monteregian Hills — Symposium, Montreal, 1969, Proc.: Canadian Mineralogist, v. 10, pt. 3, p. 375-379, illus., table, 1970.

K, Rb, Sr, Ba, and rare-earth data and partition coefficients indicate the plausibility of alkali basalts and subalkaline basalts being derived by limited and extensive fusion respectively of residual material created during continent formation. — Authors' abstract

Phinney, R. A. *See* Chapman, C. H. 05843

Picard, M. Dane. *See* Andersen, D. W. 00031

05966 **Pierce, J. W.; Colquhoun, D. J.** Holocene evolution of a portion of the North Carolina coast: Geol. Soc. America Bull., v. 81, no. 12, p. 3697-3714, illus., 1970.

The study of the large barrier island chain off the coast of North Carolina concludes that the present coast line has evolved from a primary barrier by retreat and migration of headlands as well as formation of secondary barriers by spit elongation over the adjacent continental shelf. — Authors' abstract

Pinson, W. H. Jr. *See* Bottino, M. L. 06128

Platt, R. G. *See* Sood, M. K. 06109

Pollock, Samuel J. *See* Johnston, Paul M. 06146

06114 **Poulot, Gaston.** Study of carbonatitic calcites from Oka, Que. [with French abs.], *in* Alkaline rocks, the Monteregian Hills — Symposium, Montreal, 1969, Proc.: Canadian Mineralogist, v. 10, pt. 3, p. 511-540, illus., tables, 1970.

About 130 specimens of carbonatites were studied. Determination of Nb_2O_5 by X-ray fluorescence, and of Ba, Sr, Mg, Mn, and Fe in calcites by atomic absorption are covered. Physical properties studied include: lattice spacings, refractive index, axial angle, and fluorescence in absorption absorption spectra. The Nb_2O_5 content varies from .08 to 1.50 percent, and chemistry of the calcites varies widely; only Mg, Fe, and Mn show correlation with each other. Except for late calcites, which show a marked decrease in Sr and Mn, chemistry of carbonatitic calcite varies widely and sporadically. No relations could be established between calcite chemistry and niobium content. Small-scale cation substitution in the carbonate affects principally lattice spacings. Fluorescence in ultraviolet and biaxial character of some calcites do not bear simple relations to the chemistry, but may be related to thermal and structural history. — *from* Author's abstract

05903 **Poupon, A.; Gaymard, R.** The evaluation of clay content from logs: Log Analyst, v. 11, no. 6, p. 18-25, illus., 1970.

Since many log readings are substantially affected by clay in the formation, a reliable evaluation of clay content is essential in formation evaluation from logs. The method for solving this problem is based on consideration of several "clay indicators" evaluated statistically over the interval of the well to be interpreted. These are either single curves such as SP, gamma ray or neutron, or combinations of two curves such as neutron and density logs. Each clay indicator is calibrated to give either the actual clay content or an upper limit of that value. The lowest of these indications should be very close to the actual value. The method is applicable to complex lithologies as well as to shaly sands. — *from* Authors' abstract

06030 **Powell, J. Dan; Pessagno, Emile A., Jr.; McNulty, C. L., Jr.; Rothwell, W. T., Jr.; Schell, W. W.; Williams, T. E.** (editors). Field trip guidebook for the 1st Interamerican Micropaleontological Colloquium, 1970: Dallas, Tex., Univ. Texas Dallas, [127] p., illus., 1970.

This first Interamerican Micropaleontological Colloquium focuses on the classic Upper Cretaceous succession of Texas, which is structurally simple compared to such areas as the West Indies, and contains a well-preserved microfossil assemblage rich in Foraminifera, Ostracoda, nannoplankton, dinoflagellates, pollen, and spores. Included in its scope was a 10-day field trip, the road logs for which are in the first part of the appendix in this guidebook; the second part lists microfaunal assemblages for each formation, described briefly and cited separately by J. D. Powell. — GDC

06152 **Powell, J. Dan.** Summary of Upper Cretaceous stratigraphy — The Gulf of Mexico Province, *in* Interamerican Micropaleont. Colloquium, 1st, 1970, Field Trip Guidebook: Dallas, Tex., Univ. Texas Dallas, p. 9-36, A25-A91, illus., 1970.

Upper Cretaceous rocks (Cenomanian-Maestrichtian) crop out along and parallel to the structural hinge of the Gulf of Mexico Basin in Texas and adjacent areas. With few exceptions they are all marine in origin and contain a significant fossil biota. Used in brief descriptions of individual rock units, from the Washita Group to the Navarro Group, five gross lithofacies types are discernably associated with the succession of environments: (1) marginal marine-continental; (2) littoral and open bay; (3) shallow sublittoral; (4) inner-outer sublittoral; (5) outer sublittoral, but including possible shallow, far-offshore environments. Their recurrence in many of the stratigraphic units seems to demonstrate the probable sedimentary megacycle which began with the Woodbine Interval and ended with major regression depicted by the early Cenozoic Midway-Wilcox sequence. — GDC

Prentice, F. Jean. *See* Burns, Roger G. 06082

05824 **Price, Don; Bolke, E. L.** Hydrologic reconnaissance of the Sink Valley area, Tooele and Box Elder Counties, Utah: Utah Dept. Nat. Resources Tech. Pub. 26, 28 p., illus., tables, 1970.

The principal source of water for development in the Sink Valley area is ground water occurring chiefly under water-table conditions in unconsolidated and partly consolidated Quaternary and Tertiary valley fill. Sand and gravel aquifers yield up to a few hundred gpm; however, water generally contains more than 2,000 mg/l of dissolved solids, and mineral content increases with depth. It is estimated that about 370,000 acre-feet of recoverable ground water is stored in the upper 40-60 feet of saturated fill, but annual amount of recharge to the reservoir is only about 1,000 acre-feet. The small quantity of water that moves through the reservoir annually and poor quality are principal limiting factors in any major development of resources. — *from* Authors' abstract

05892 **Prodehl, Claus.** Crustal structure of the western United States from seismic-refraction measurements in comparison with central European results [with German summ.]: Zeitschr. Geophysik, v. 36, no. 4, p. 477-500, illus., table, 1970.

Reinterpretation of a network of 64 refraction profiles recorded in 1961-63 in the United States west of long 106° W., yields a basic traveltime curve similar to that for central Europe. In profiles in the Snake River plain, northern Basin and Range province, and central Rocky Mountains, two dominant phases in secondary arrivals can be correlated; in other areas there is only one. Velocity inversions within the upper 20 km of the crust are indicated under the southern Cascade Range, central Rocky Mts., and part of the Basin and Range province. A transition zone between upper and lower crust is indicated under the northern Basin and Range province and central Rocky Mts. Velocities at the base of the crust and in the uppermost mantle are 7.3-7.9 kmps for most western United States; in southern California and the central Rocky Mts. they are 8.0 kmps or more. Crustal thicknesses range from 24-26 km (under Coast Range of central California) to 45 km (under central Rocky Mts.). — DBV

00037 **Pryor, Wayne A.; Amaral, Eugene L.** Large-scale cross-stratification in the St. Peter Sandstone: Geol. Soc. America Bull., v. 82, no. 1, p. 239-243, illus., 1971.

Large-scale cross-stratification is present in the St. Peter Sandstone of southern Wisconsin. Sets of cross-bedding are as much as 35 feet thick and are made up of thick master fore-set units which contain sets of smaller scale, internal cross-stratification. The master fore-set units occur as two types of cross-stratification: convex upward, planar and convex downward, tangential. Both the large-scale master foreset bedding and the small-scale internal fore-set bedding dip toward the southwest, parallel to the regional paleocurrent pattern. The large-scale cross-stratification in the St. Peter Sandstone is the result of internal structures developed in large migrating sand waves, dunes, banks, or ridges. — Authors' abstract

05834 **Psuty, Norbert P.** (compiler). A bibliography of Latin American coastal geomorphology: Pan American Inst. Geography and History Spec. Pub. 1, 12 p., 1970.

Author entries are listed alphabetically; there is no index.

06007 **Puffer, John Harold.** Magnetite and ilmenite in the granitic rocks of the Pegmatite Points area, Colorado [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 12, pt. 1, p. 5559B-5560B, 1970.

Qamar, Anthony. *See* Carder, D. S. 06410

06387 **Rabchevsky, George.** Remote sensing of the Earth's surface — Pt. 2, Remote sensing and sensors: Jour. Remote Sensing, v. 1, no. 4, p. 5, 15-17, tables, 1970.

Aerial photographs of the Earth's surface are considered to be the earliest of remote sensor data. One hundred and twelve years have passed since the first of such photographs was taken from a balloon. During this period, massive amounts of literature have accumulated that deal with the various phases of remote-sensing techniques, interpretations, and applications. This paper was compiled from existing literature on remote sensing and is intended to present the state-of-the-art on this subject. — Author's abstract

Rader, Miles. *See* Krinitzsky, E. L. 06222

Rahm, David A. *See* Easterbrook, Don J. 05977

05889 **Ramachandran, G. N.; Srinivasan, R.** Fourier methods in crystallography: New York and London, Wiley-Interscience, 259 p., illus., tables, 1970.

Fourier series and Fourier transforms play a fundamental part in calculating the X-ray diffraction patterns of crystals and in the inverse problem of determining the molecular structure from the diffraction pattern. This monograph deals essentially with aspects of these problems, particularly for a periodic crystal. — VSN

06329 **Raup, Omer B.** Brine mixing — An additional mechanism for formation of basin evaporites: Am. Assoc. Petroleum Geologists Bull., v. 54, no. 12, p. 2246-2259, illus., tables, 1970.

Experiments using artificial and seawater brines indicate that halite and sylvite can be precipitated by mixing brine of differing stages of evaporation, in addition to the previously recognized mechanisms of direct evaporative crystallization and crystallization by temperature change. A modification of present geologic models is proposed to show how brine mixing might work in an evaporite basin. Conclusions based on the experiments and their relations to the geologic model are as follows: (1) Salt can precipitate in a marine evaporite basin by mixing brines of different composition and specific gravity. (2) Precipitation may occur without further water loss by evaporation. (3) Precipitation can take place from brines that were undersaturated before mixing. (4) Brine mixing would cause the most salt to be deposited in the deepest parts of a basin, although nearly all parts of the basin could receive such deposits. (5) Sylvite could be precipitated as a primary mineral. (6) Hopper crystals (cubic and tabular) can form as a result of brine mixing in water of any depth. — Author's abstract

Raymond, William H. *See* Desborough, George A. 06176

Readman, P. W. *See* Runcorn, S. K. 06292

Reed, Bruce L. *See* Anderson, Lennart A. 06175

06125 **Reid, John R.** Late Wisconsin and Neoglacial history of the Martin River Glacier, Alaska: Geol. Soc. America Bull., v. 81, no. 12, p. 3593-3603, illus., 1970.

The outermost terminal moraine of the Martin River Glacier, in south-central Alaska, is anomalously late Wisconsin in age; all lateral moraines converge at or up-glacier from this moraine, indicating that if the glacier ever extended farther downvalley, the evidence is still missing. It is possible, however, that before then it was a tide-water glacier. Debris-covered dead ice near the present terminus marks the maximum Neoglacial advance, which culminated about 1650 A.D. The main lobe has been in retreat since then. The close proximity of the Neoglacial limit to the terminal moraine is probably the result of tectonic uplift of the Chugach Mountains in Neoglacial time. The change in the accumulation area may have diverted more ice from the Bagley Ice Field into the Martin River Glacier. It may also have initiated the surging flow that has occurred in this and the neighboring Bering Glacier. Neoglacial uplift has complicated the interpretation of the past history of the Martin River Glacier. — *from* Author's abstract

00006 **Reimnitz, Erk.** Surf-beat origin for pulsating bottom currents in the Rio Balsas submarine canyon, Mexico: Geol. Soc. America Bull., v. 82, no. 1, p. 81-89, illus., 1971.

During large surf, river discharge deflects pulsating longshore current (peaking at over 7 km/hr) seaward over a canyon tributary heading in the surf zone. Pulsating flow occasionally enters the river mouth, causing rhythmic fluctuations. At the bottom of the tributary at a depth of 18 m, current pulses with estimated velocities of 4 km/hr transported large amounts of suspended sand down an axial slope of 26°. This bottom flow, at least 3 m thick, pulsates in phase with the surface rip current. Character of canyon fill indicates net deposition on the steeply sloping floor. Esti-

mated water budget suggests that the bottom flow, landward of the dive site, probably separated from the surface flow and was propagated downslope as a turbidity current. Its magnitude was sufficient to erode the canyon walls. Thus, rip currents play a role in formation of some submarine canyons. — *from* Author's abstract

Reso, Anthony. *See* Johnson, J. G. 05811

Ribbe, P. H. *See* Brown, G. E. 06074

05804 **Rich, Mark.** The genus *Tuberitina* (Foraminiferida) in Lower and Middle Pennsylvanian rocks from the eastern Great Basin: Jour. Paleontology, v. 44, no. 6, p. 1060-1066, illus., 1970.

The [nodosinellid] genus *Tuberitina* is widespread in Lower and Middle Pennsylvanian rocks in eastern Nevada and western Utah. Two species, *T. bulbacea* Galloway and Harlton and *T. maljavkini* Suleimanov have been recognized; the latter species is more variable and more widespread. *Tuberitina* occurs most commonly in mud-supported and grain-supported calcarenitic limestone (wackestone and packstone, respectively, of Dunham, 1962), and is generally associated with the alga, *Dvinella* and the stromatoporoid or alga, *Komia*, indicating that it was selective for a particular environment which is interpreted to have been one of relatively shallow to moderate water depths, of low to moderate energy, and of low terrigenous influx. — Author's abstract

Richardson, Darlene S. *See* Kerr, Paul F. 05794

Ridley, William I. *See* Baker, Ian. 06052

05810 **Rigby, J. Keith.** *Brachiospongia tuberculata* James from the Ordovician of central Ontario: Jour. Paleontology, v. 44, no. 6, p. 1139-1142, illus., 1970.

An unusually well preserved, nearly complete specimen of this sponge is described from Middle Ordovician (Trentonian) rocks near Kirkfield, Ontario. — JWH

05861 **Rigby, J. Keith.** *Ellesmerespongia feildeni*, a new Permian sponge from the Canadian Arctic: Jour. Paleontology, v. 44, no. 6, p. 1143-1145, illus., 1970.

A new genus and species of astylospongid from a fusulinid-bearing unnamed Lower Permian limestone on the Feilden Peninsula, Ellesmere Island, is described and illustrated. In the single specimen, coarse calcification has obliterated much of the finer texture except in limited areas where silicification has preserved details of spicule structure, visible in thin section as ghosts. — JWH

06334 **Riker, E. P.** Norman Lee Johnson (1926-1970): Am. Assoc. Petroleum Geologists Bull., v. 54, no. 12, p. 2448, portrait, 1970.

Riley, D. L. *See* Herzenberg, C. L. 06284

06256 **Ringwood, A. E.** Petrogenesis of Apollo 11 basalts and implications for lunar origin: Jour. Geophys. Research, v. 75, no. 32, p. 6453-6479, illus., tables, 1970.

Major- and trace-element contents of Apollo 11 basalts can be explained by partial melting of source material that buffers major-element compositions and causes enrichments in incompatible elements according to degree of partial melting. Suggested alternative sources for basalts so formed are: unfractionated pyroxenite source region at 200-600 km depth, and fractionated source region with approximately eucritic composition. The first alternative can explain major-element chemistry and trace-element abundances in terms of a simple single-stage model. If lunar highlands are anorthositic, extensive differentiation in the outer 150 km of the Moon is required; this may have been caused by heating arising from partial conservation of gravitational potential energy during final accretion. The basalts were probably formed deep in the interior 3.7 m.y. ago as a result of radioactive heating. A two-stage magmatic history is thus required. — DBV

Robertson, D. E. *See* Spencer, Derek W. 06407

06418 **Robertson, J. A.** Township 1A, District of Algoma: Ontario Dept. Mines and Northern Affairs Prelim. Geol. Map P. 610, scale 1 in. to 1/4 mi., text, 1970.

Rocks of Townships 1A and 1B are classified into: Archean basement, Huronian sedimentary rocks, post-Huronian mafic intrusions, and Pleistocene and Holocene unconsolidated sediments. Several types of mineralization have been found. — MCM

06419 **Robertson, J. A.; Johnson, J. M.** Township 1B, District of Algoma: Ontario Dept. Mines and Northern Affairs Prelim. Geol. Map P. 609, scale 1 in. to 1/4 mi., text, 1970.

The text is the same as that for Township 1A (Robertson, 1970).

06192 **Robertson, John B.** Vertical molecular diffusion of xenon-133 gas after injection underground, *in* Geological Survey research 1970, Chap. D: U.S. Geol. Survey Prof. Paper 700-D, p. D287-D300, illus., tables, 1970.

Nine hundred and eighty-seven curies of radioactive Xe-133 gas mixed with 2.83×10^4 m^3 of air was injected rapidly into permeable basalt strata at the National Reactor Testing Station, Idaho; a capping layer of fine-grained playa sediments confined the gas underground. Subsurface Xe-133 was monitored by GM detectors and by air samples from observation wells surrounding the injection well. Underground distribution patterns after injection pressures had dissipated were evaluated by materials-balance analyses. Most Xe-133 apparently remained underground and decayed radioactively. Molecular diffusion rates of Xe-133 from the ground were estimated using a simplified mathematical model. A maximum flux rate of 2,560 μc/hr from a ground-atmosphere interface area of 2.67×10^5 m^2 was calculated for the first day after injection. Estimated rates indicated a total diffusion loss of 0.37 c for the total area during the 26-day observation period. — *from* Author's abstract

Robie, R. A. *See* Waldbaum, D. R. 05788

Robinson, K. G. *See* Brown, G. E. 06074

Robinson, P. D. *See* Fang, J. H. 05935

Robson, G. R. *See* Andrew, E. M. 05835

05785 **Rochester, Eugene W., Jr.; Kriz, George J.** Potable water availability on long oceanic islands: Am. Soc. Civil Engineers Proc., v. 96, paper 7627, Jour. Sanitary Eng. Div., no. SA5, p. 1235-1248, illus., 1970.

Potable ground water supplies on oceanic islands are in the form of freshwater lenses floating on the more dense salt water. Indiscriminate pumping of this water can result in its contamination by salt water. The extent of the fresh water lens on long oceanic islands [such as off North Carolina] is predicted from results of a Hele-Shaw model study. The locations of the freshwater free surface and the freshwater-salt-water interface are presented graphically as a function of soil characteristics, island dimensions, and average infiltration rate. The effect of pumping from a horizontal gallery located at the island midpoint is also presented graphically. The maximum safe pumping rate for a horizontal gallery located at the island midpoint is predicted as a function of the net average infiltration rate. — ASCE abstract

06375 **Rodda, Peter U.; Garner, L. E.; Dawe, G. L.** Geologic map of the Austin West quadrangle, Travis County, Texas: Texas Univ. Austin Bur. Econ. Geology Geol. Quad. Map 38, scale 1:24,000, separate text by P. U. Rodda, 1969 [1970].

Rocks exposed in the Austin West quadrangle are Cretaceous marine limestones and clays and Quaternary alluvial deposits. Most faults are downthrown to the east; total displacement across the fault zone is about 1,000 feet. Terrace deposits, mostly sand and gravel, parallel the Colorado River; other alluvial deposits are developed along tributary streams. Limestone units are stable and resistant, difficult to excavate, have

mostly moderate to high permeability, pose few engineering problems, and are sources of stone and building materials; one unit (Edwards Formation) is an important aquifer. Clay units are weak, unstable, impermeable, and corrosive and generally require special engineering designs. -- *from* Authors' abstract

Rodriguez-Torres, Rafael. *See* Cordoba, Diego A. 05913

06181 **Roehler, Henry W.** Nonopaque heavy minerals from sandstone of Eocene age in the Washakie Basin, Wyoming, *in* Geological Survey research 1970, Chap. D: U.S. Geol. Survey Prof. Paper 700-D, p. D181-D187, illus., table, 1970.

Nonopaque heavy minerals were studied from 44 fine-grained sandstones of Eocene age in the Washakie Basin, Wyo. The results indicate that rocks of early Eocene age were derived chiefly from plutonic rocks in nearby mountains, whereas rocks of late Eocene age were derived chiefly from those produced by distant volcanism. — Author's abstract

Roen, John B. *See* Miller, Ralph L. 00028

06402 **Roether, Wolfgang; Münnich, Karl-Otto; Östlund, H. Göte.** Tritium profile at the North Pacific (1969) Geosecs intercalibration station: Jour. Geophys. Research, v. 75, no. 36, p. 7672-7675, illus., table, 1970.

A detailed tritium concentration profile at the Geosecs (1969) station in the North Pacific has been measured. From 0 to 150 meters values are relatively constant at . 23 TU, and then decrease rapidly to < 0.2 TU at 400 meters and greater depths. Agreement between the Heidelberg and Miami laboratories is excellent. — Authors' abstract

05800 **Rona, Peter A.** Reply [to discussion by H. A. Meyerhoff of "Comparison of continental margins of eastern North America at Cape Hatteras and northwestern Africa at Cap Blanc," 1970]: Am. Assoc. Petroleum Geologists Bull., v. 54, no. 11, p. 2216-2218, illus., 1970.

The original paper was published *in* ibid., v. 54, no. 1, p. 129-157, 1970; *see* Abs. North American Geology, July 1970.

06322 **Rooney, Lawrence F.** High-calcium limestone and high-magnesium dolomite resources of Indiana: Indiana Geol. Survey Bull. 42-B, 20 p., illus., tables, 1970.

This report discusses sources and uses of high-calcium imestone and high-magnesium dolomite in Indiana. It includes tables of chemical analyses and a map of bedrock distribution of principal carbonate rocks in the state. Chief sources of high-calcium limestone are the Salem, Harrodsburg and Ste. Genevieve Limestones (Mississippian), the Jeffersonville and North Vernon Limestones (Devonian), and the Detroit River and Traverse Formations (Devonian). The Salamonie Dolomite, Louisville Limestone and Wabash Formation contain units up to 125 feet thick of high-magnesium dolomite more than 99 percent pure. The Geneva Dolomite also contains some. The limestone is chiefly used for agricultural limestone and lime, the dolomite for fluxstone, lime, refractories, dead-burned dolomite and magnesium compounds. — EH

06433 **Roper, Paul J.; Dunn, David E.** Geology of the Tamassee, Satolah and Cashiers quadrangles, Oconee County, South Carolina: South Carolina Div. Geology Map Ser. MS-16, scale 1:24,000, sections, separate text (55 p., illus., tables), 1970.

Metasedimentary rocks make up the country rock of the Tamassee, Satolah and Cashiers quadrangles; mechanical deformation and cataclasis increase in intensity from the Blue Ridge to the Brevard Zone. The first and most intense metamorphism is in the almandine-amphibolite facies, the second is related to shearing and is retrogressive, producing minerals typical of the greenschist facies. Such features as refolded isoclines, diverse lineations, and complex faulting are characteristic. The most valuable mineral resource is granite or granite gneiss which could be used for building stone and crushed stone. — MCM

06008 **Rose, Peter Robert.** Edwards Formation, surface and subsurface, central Texas [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 12, pt. 1, p. 5560B, 1970.

Rosenfeld, John L. *See* Adams, Herbert G. 06038

06028 **Ross, Clyde P.** The Precambrian of the United States of America — Northwestern United States, the Belt Series, *in* The geologic systems — The Precambrian, V. 4 (Kalervo Rankama, editor): New York and London, Interscience-John Wiley and Sons, p. 145-251, illus., tables, 1970.

The Belt Series is a provincial series of Precambrian age in northwestern U.S., including Montana, Idaho, and eastern Washington, and extending into British Columbia and Alberta. It is feebly metamorphosed, and the original sedimentary characteristics are so obvious that customary stratigraphic methods may be used in studying the series. It shares with analogous units in other countries uncertainties as to whether Cambrian beds are included in it. The series consists mainly of sedimentary rocks with intercalated lava flows; in some places stromatolites are found but are of no stratigraphic value except as local horizon markers. Existing data on the series are summarized, and provisional conclusions are presented on salient points regarding both the Belt Series and similar units in eastern North America and other parts of the world. A correlation table is included. — VSN

Ross, D. C. *See* Dodge, F. C. W. 06211

06119 **Ross, Donald C.** Quartz gabbro and anorthositic gabbro, markers of offset along the San Andreas Fault in the California Coast Ranges: Geol. Soc. America Bull., v. 81, no. 12, p. 3647-3661, illus., tables, 1970.

Distinctive gabbros at Logan, Gold Hill, and Eagle Rest Peak along the San Andreas fault may be gabbroic oceanic crust that lies near a continental-oceanic interface. This interface is thought to represent a pre-Eocene or pre-Cretaceous fossil subduction zone between Franciscan and Sierran basements. Right lateral movement on the San Andreas fault has left slivers of these gabbroic rocks at Logan and Gold Hill (100 mi apart). If Eagle Rest Peak is an in-place exposure and correlations are correct, right lateral movement has been 200 mi. If anorthositic gabbro clasts in Cretaceous conglomerates in the Gualala area were derived from the Eagle Rest Peak area, movement on the San Andreas fault would be 350 mi. — HCW

Rossmann, Ronald. *See* Bowser, Carl J. 06070

Rossmann, Ronald. *See* Callender, Edward. 06085

Rothwell, W. T., Jr. *See* Powell, J. Dan. 06030

05960 **Rowan, L. C.; Offield, T. W.; Watson, Kenneth; Cannon, P. J.; Watson, R. D.** Thermal infrared investigations, Arbuckle Mountains, Oklahoma: Geol. Soc. America Bull., v. 81, no. 12, p. 3549-3561, illus., 1970.

Thermal-infrared images of two areas underlain by carbonate, clastic rocks, and granite were studied to evaluate their usefulness in structural geologic investigations. Images were obtained at 6 a.m., 11 a.m., and 2 p.m. The predawn image was most useful in distinguishing thermal contrasts in rock types and fault and fracture zones, while the daytime images displayed much stratigraphic and structural detail in low (a.m.) and high (p.m.) relief areas. Thermal contrasts arise from a combination of albedo and thermal-inertia characteristics of the rocks, and the differences in features in a.m. and p.m. images appear to be a function of insolation and topography. In addition, certain lineaments are preferentially enhanced in a.m. or p.m. images but not both, possibly by ground-water and vegetation effects. — *from* Authors' abstract

06236 **Rowan, L. C.; Cannon, P. J.** Remote-sensing investigations near Mill Creek, Oklahoma: Oklahoma Geology Notes, v. 30, no. 6, p. 127-134, illus., 1970.

Remote-sensing investigations by the U.S. Geological Survey at Mill Creek, Okla., have demonstrated the usefulness in the test site of side-looking radar images for delineating fractures and faults and of infrared (8-14 μm) images for discriminating limestone, dolomite, and granite. The thermal contrast of the limestone and dolomite in the predawn image can be explained in terms of the thermal and reflectivity properties of the two rock types. — Authors' summary

Rubin, Meyer. *See* Sirkin, Leslie A. 06170

Ruch, R. R. *See* Bradbury, J. C. 06321

Ruffman, A. *See* Berggren, W. A. 06160

06292 **Runcorn, S. K.; Collinson, D. W.; O'Reilly, W.; Battey, M. H.; Stephenson, A.; Jones, J. M.; Manson, A. J.; Readman, P. W.** Magnetic properties of Apollo 11 lunar samples, *in* Apollo 11 Lunar Sci. Conf., Houston, Tex., 1970, Proc. — V. 3, Physical properties: New York, and Oxford, England, Pergamon Press (Geochim. et Cosmochim. Acta Supp. 1), p. 2369-2387, illus., 1970.

The magnetic properties of samples of rock, fines and magnetic separate from the fines from the Apollo 11 mission have been measured. Native iron, or possibly a very dilute nickel-iron, about 5 percent by weight of the rock and mostly of sub-microscopic particle size, is the most important magnetic constituent of the fines and breccia; there is a minor contribution from troilite, ilmenite, paramagnetic iron minerals and other iron-titanium oxides. The remanent magnetization of a sample of the microbreccia was found to be a viscous magnetization acquired in a weak field and it does not appear to possess a stable remanence; the crystalline rock has a weak remanence (about 6×10^{-6} e.m.u./g) which requires a peak demagnetizing field of 500 oe to remove it. The association of the latter remanent magnetization with a lunar magnetic field in the past is discussed. — Authors' abstract

06210 **Russell, Dale A.** Tyrannosaurs from the Late Cretaceous of western Canada [with French abs.]: Canada Natl. Mus. Nat. Sci. Pubs. Palaeontology, no. 1, 34 p., illus., tables, 1970.

Tyrannosauridae are a small family of closely related large theropodous saurischians from the Upper Cretaceous of western interior North America and central Asia. *Albertosaurus* Osborn is recognized as a senior synonym of *Gorgosaurus* Lambe, and all species formerly referred to the latter are transferred to the former genus. *A. sternbergi* and *A. arctunguis* are junior synonyms of *A. libratus* (Lambe) and *A. sarcophagus* Osborn (the genotype), respectively, which occur in the Oldman and lower Edmonton Formations of Alberta, respectively. *Daspletosaurus torosus*, n.gen., n.sp., is described from the Oldman Formation, and a comparable half-grown specimen from the lower Edmonton. Nearly complete specimens of *A. libratus* and *D. torosus* permit reconstruction of skull anatomy and mechanism and, for *A. libratus*, an allometric growth pattern of ontogeny. — VMJ

Ryan, J. A. *See* Grossman, J. J. 06281

06171 **Sable, Edward G.** Source areas of Lower Mississippian red beds in eastern midcontinent, *in* Geological Survey research 1970, Chap. D: U.S. Geol. Survey Prof. Paper 700-D, p. D88-D91, illus., table, 1970.

Distribution and facies of red beds of Early Mississippian (early Osage) age in Missouri, Illinois, Indiana, and Michigan suggest that most of their terrigenous detritus was derived from a broad lowland area to the northwest which included the Transcontinental and Wisconsin arches. These sediments were deposited along a southwest-trending shelf which was marginal to deeper water to the east. Red beds in central Indiana and parts of southern Ohio and northeastern Kentucky seem to indicate mild emergence of the Cincinnati arch area during this time. — Author's abstract

06187 **Sakamoto, Kenji.** Some techniques for photographing fossils, *in* Geological Survey research 1970, Chap. D: U.S. Geol. Survey Prof. Paper 700-D, p. D230-D232, illus., 1970.

A newly designed electrically heated spray gun incorporating a variable transformer and using a filtering substance provides a safe and improved method of coating fossils with ammonium chloride sublimate. A photographic technique for producing an initial white background on photographs of megafossils provides a more accurate representation of specimens than do the conventional methods of removing the normal black background by opaquing the negative or trimming the print. This method also permits a significant saving of time over the other methods, particularly opaquing. — Author's abstract

Salisbury, John W. *See* Hunt, Graham R. 06394

Sammis, Charles. *See* Archambeau, Charles B. 06046

06448 **Sangster, D. F.** Metallogenesis of some Canadian lead-zinc deposits in carbonate rocks [with French abs.]: Geol. Assoc. Canada Proc., v. 22, p. 27-36, illus., 1970.

Of three main types of lead-zinc deposits in carbonate rocks recognized in Canada, two may be termed conformable. One, peripheral to or between undeformed sedimentary basins in clean, massive or coarse-bedded, vuggy, sometimes reefal dolomite, consists of massive to disseminated sulfides; Pine Point is of this type. In contrast, the other occurs in intensely deformed, dark, well-bedded dolomite intruded by rocks of granitic to intermediate composition; sulfide bodies are layered and may be deformed and/or thermally metamorphosed, as at Remac mine in the Kootenay Arc. Several lines of evidence suggest the two types are similar in origin but not in time of placement. The third type, nonconformable, is typically Pb(Zn)-Ag-barite veins, as found in the marble belt of southern Grenville province, where evidence suggests their relation to the Ottawa Valley graben structure of Cretaceous(?) age, and not to Cambrian host rocks.—*from* Author's abstract

Sauer, E. K. *See* MacDonald, A. B. 06358

05817 **Savage, C. N.** Evaluation of minerals and mineral potential of the Salmon River drainage basin in Idaho: Idaho Bur. Mines and Geology Pamph. 147, 64 p., illus., tables, 1970.

A minerals evaluation of the Salmon River basin was made in connection with the project for development of methodology for evaluation of wild and scenic rivers in Idaho, and is an example of a method of approach to be applied to any river in the state. Known mineral locations and developments are described. Data are included on mineral exploration, development, and operation in relation to multipurpose land use and their effects on the land surface. Development of minerals is necessary and can be done, with controls, within the concept of environmental protection. — EH

06464 **Savage, J. C.; Burford, R. O.** Accumulation of tectonic strain in California: Seismol. Soc. America Bull., v. 60, no. 6, p. 1877-1896, illus., tables, 1970.

Shear-strain accumulation in five areas of California has been calculated from triangulation. Near Hollister, no strain accumulation was detected for 1930-1962; fault-block movement there appears accommodated by slip on the San Andreas and Calaveras faults. Near Cholame, the only appreciable accumulation of shear strain in 1932-1962 appears associated directly with slip on the San Andreas, probably during the 1934 Parkfield earthquake. Significant strain accumulation was confined to a 20-km-wide zone centered on San Andreas fault; some of this was released in the 1966 Parkfield earthquake. In Imperial Valley, accumulation of shear strain extends over a zone 100-km wide centered on Imperial fault; this shear pattern may be resolved into two shear zones, one concentrated near the Imperial and the other near the San Andreas. No appreciable shear-strain accumulation was detected in Santa Barbara channel for 1880-1923 and in Owens Valley for 1934-1956. — DBV

Schaber, G. G. *See* Shoemaker, E. M. 06294

06437 **Schaeffer, O. A.; Funkhouser, J. G.; Bogard, D. D.; Zähringer, J.** Potassium-argon ages of lunar rocks from Mare Tranquillitatis and Oceanus Procellarum: Science, v. 170, no. 3954, p. 161-162, illus., table, 1970.

Crystalline rocks from Mare Tranquillitatis have yielded potassium-argon dates as old as 3.8 b.y. Crystalline rocks from Oceanus Procellarum give potassium-argon ages as old as 2.8 b.y. Evidently the maria are ancient features of the Moon and were not formed contemporaneously, a conclusion that also has been verified by other methods. The potassium-argon ages of rocks from Oceanus Procellarum show much more loss of argon than the rocks from Mare Tranquillitatis, an indication that the rocks at Oceanus Procellarum have experienced more severe shock effects or longer cooling rates. — Authors' abstract

Scharff, John. *See* Jackman, E. R. 05921

Schell, W. W. *See* Powell, J. Dan. 06030

Scheuch, Jorn. *See* Kullmann, Jurgen. 05982

Schleicher, D. L. *See* Shoemaker, E. M. 06294

05795 **Schneider, E. D.; Johnson, G. L.** Deep-ocean diapiric occurrences: Am. Assoc. Petroleum Geologists Bull., v. 54, no. 11, p. 2151-2169, illus., 1970.

Sea-floor diapiric structures are widespread and occur in the western Mediterranean, eastern and western Atlantic, and in the Pacific. Diapiric features in the Atlantic are postulated to have formed in a narrow but growing Mesozoic proto-Atlantic. The early Atlantic was marked by restricted circulation with resultant deposition of evaporite deposits. In post-Cretaceous time a strong thermohaline circulation pattern was initiated in response to widening of the Atlantic and addition of cold polar waters, which changed the environment from reducing to oxygenated. — *from* Authors' abstract

06023 **Schneider, Howard John.** Paleobiochemistry of algae [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 12, pt. 1, p. 5619B, 1970.

05840 **Schneider, William J.** Hydrologic implications of solid-waste disposal: U.S. Geol. Survey Circ. 601-F, p. F1-F10, illus., tables, 1970.

Among problems created by disposal of more than 1,400 million pounds of solid wastes in the United States each day, is the pollution of ground-water resources. Open dumps, sanitary landfill, incineration, and onsite disposal methods carry an inherent pollution potential. Seepage of rain water through wastes leaches undesirable constituents which reach the ground water; the leachate is generally biologically and chemically contaminated. Extent of pollution from leachate is largely dependent upon geologic environment of the deposit area; potential is highest in permeable areas with a shallow water table and is generally confined locally to vicinity of the site in a relatively impermeable area. Site selection must be based on adequate water-resources information, requiring both regional and localized data. — *from* Author's abstract

Schnetzler, C. C. *See* Philpotts, John A. 06108

00034 **Schoettle, Manfred; Friedman, Gerald M.** Fresh water iron-manganese nodules in Lake George, New York: Geol. Soc. America Bull., v. 82, no. 1, p. 101-110, illus., tables, 1971.

A new discovery of iron-manganese nodules was made in Lake George at a water depth of 21-36 m along about a ten-mile stretch of the lake. Nodules occur on or in the uppermost 5 cm of a varved glacial clay. Some areas are solidly floored with a carpet of nodules in areas where currents keep the nodules exposed. The nodules form around nuclei which consist of clay and less commonly spore capsules, detrital particles, or bark. X-ray examination of nodules shows small goethite peaks; one contained birnessite. Manganese and part of the iron appear to be in amorphous fer-

romanganese compounds. The Lake George nodules are enriched in iron with respect to marine nodules but are lower in manganese. They have a higher trace-element concentration than nodules from other known fresh-water lake occurrences, but a lower concentration than marine nodules. — *from* Authors' abstract

05962 **Scholl, David W.; Greene, H. Gary; Marlow, Michael S.** Eocene age of the Adak 'Paleozoic(?)' rocks, Aleutian Islands, Alaska: Geol. Soc. America Bull., v. 81, no. 12, p. 3583-3591, illus., table, 1970.

In 1948, several specimens identified as the plant genus *Annularia*, of Pennsylvanian or Permian age, were found in tuffaceous sandstone on northern Adak Island. These beds form the basal part of the Andrew Lake Formation, a newly named sequence of marine sedimentary rocks more than 850 m thick. This formation rests depositionally(?) on the Finger Bay Volcanics, which make up most of the island. Mollusks and other fossils of probable Eocene and Oligocene age occur in the lower 350 m of beds overlying the basal *Annularia* beds. The matrix surrounding specimens of *Annularia* contains dinoflagellates that establish that these beds also are marine units of Eocene age. The Andrew Lake Formation probably accumulated in a perched basin along the crestal region of an early Tertiary Aleutian Ridge. There is little evidence that the ridge existed in Mesozoic time. — *from* Authors' abstract

05973 **Scholten, Robert.** Origin of the disturbed belt in northwestern Montana — Discussion [of paper by M. R. Mudge, 1970]: Geol. Soc. America Bull., v. 81, no. 12, p. 3789-3792, 1970.

For the paper under discussion, *see* ibid., v. 81, no. 2, p. 377-392, 1970; Abs. North American Geology, July 1970.

Scholz, Christopher. *See* Anderson, Orson L. 06267

05969 **Schopf, Thomas J. M.** Taxonomic diversity gradient of ectoprocts and bivalves and their geologic implications: Geol. Soc. America Bull., v. 81, no. 12, p. 3765-3768, illus., 1970.

Important attributes of some taxonomic diversity gradients of marine organism include an "ocean effect" and a "margin effect." As examples of the former, both ectoprocts and bivalves are twice as diverse in the Pacific Ocean as in the Atlantic Ocean. As examples of the latter, bivalves and, less clearly, ectoprocts have their greatest within-ocean diversity along the western margin of the Pacific and the eastern margin of the Atlantic Ocean. Correct determination of the paleo-equator may be severely hampered unless the data include samples from the Pacific Basin. Although ectoprocts and bivalves are equally diverse at low latitudes, ectoprocts have markedly more species per geographic area at high latitudes. — Author's abstract

Schreiber, Edward. *See* Anderson, Orson L. 06267

00023 **Schreiber, John P.; Breed, William J.** Obsidian localities in the San Francisco volcanic field, Arizona: Plateau, v. 43, no. 3, p. 115-119, illus., 1971.

In an attempt to relate obsidian found in archaeological sites in northern Arizona to its source area, nine obsidian outcrops in the San Francisco volcanic field were located. Although it is not possible to differentiate this obsidian megascopically, it is possible to divide the field into four chemical groups by X-ray fluorescence. — Authors' abstract

06395 **Schwalb, Howard R.; Smith, Juanita G.** Catalog of well samples and cores on file at Kentucky Geological Survey: Kentucky Geol. Survey, ser. 10, Inf. Circ. 19, 182 p., illus., table, 1970.

This catalog revises, supplements, and supersedes two earlier publications of the Kentucky Geological Survey: "Index list of well cuttings. . .," by H. B. Wood and A. J. Walker (ser. 9, Inf. Circ. 7, 1956); and "Supplement to Index list of well cuttings. .

.," by A. C. Pitts, D. S. Fullerton, and T. J. Crawford (ser. 10, Inf. Circ. 3, 1960). More than 10,000 sets of cores are listed for Kentucky, and 260 sample sets from wells in adjoining states are on file. Samples processed after May 9, 1969, are not included. Many corrections and additions have been incorporated, but notice of further ones is requested of the users of this report. — GDC

06293 **Schwarz, E. J.** Thermomagnetics of lunar dust sample 10084-88, *in* Apollo 11 Lunar Sci. Conf., Houston, Tex., 1970, Proc. — V. 3, Physical properties: New York, and Oxford, England, Pergamon Press (Geochim. et Cosmochim. Acta Supp. 1), p. 2389-2397, illus., table, 1970.

The thermomagnetic curves for lunar dust sample 10084-88 show the presence of virtually pure iron and possibly other iron alloys with up to 30 percent Ni. The partial hysteresis curves before heating indicate the presence of about 0.5 percent metallic iron. The mass susceptibility suggests the presence of some superparamagnetic iron. The thermomagnetic curves show strong irreversibility, due to a gradual change of the iron alloys — possibly α-γ phase transitions, or loss of ferromagnetic iron during heating in low oxygen fugacities. The mechanism proposed is progressive oxidation to FeO at high temperatures followed by dissociation of FeO to Fe and Fe_3O_4 below 570°C. The generated Fe and Fe_3O_4 may well be in the superparamagnetic state, which would explain the decrease in hysteresis and increase in high field susceptibility by a factor of 2 after heating to 800°C or more. — DBV

Schwarz, E. J. *See* Larochelle, A. 06353

06009 **Schwarzer, Rudolph Reynolds.** The concentration and distribution of uranium in coexisting pegmatite feldspars by the fission track method [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 12, pt. 1, p. 5560-5561, 1970.

05931 **Schwerdtner, W. M.** Lattice-orienting mechanisms in schistose anhydrite [with German abs.], *in* Experimental and natural rock deformation — Internat. Symposium, Darmstadt, Germany, 1969, Proc. (P. Paulitsch, editor): Berlin and Heidelberg, Germany, Springer-Verlag, p. 142-164, illus., tables, 1970.

Grain-fabric patterns for schistose anhydrite are compared with qualitative model patterns for three lattice-orienting mechanisms: intercrystalline rotation during mylonitization, intracrystalline rotation during plastic flow, and syntectonic recrystallization. These model patterns are referred to principal directions of deviatoric stress. Anhydrite tectonites are commonly pervaded by closely spaced discontinuity planes, along which no large shear stresses can be supported. Thus principal stresses tend to remain subnormal and subparallel to dominant planar discontinuity, but may rotate within this plane. Natural fabric patterns of anhydrite agree well with models for syntectonic crystallization which seems to have been the main orienting mechanism. — *from* Author's abstract

Scott, Robert B. *See* Burkett, David H. 06081

06441 **Sedam, A. C.; Stein, R. B.** Saline ground-water resources of Ohio: U.S. Geol. Survey Hydrol. Inv. Atlas HA-366, 2 sheets, scale 1:500,000, text, 1970.

The first step in a state-wide assessment of Ohio's saline ground-water resources is the identification and mapping of the base of potable water. Many domestic wells yield water with dissolved solids contents greatly in excess of recommended limits for drinking water. The principal source of potable water is the water-course aquifers of glacial origin; many bedrock aquifers are used regionally or locally. The aquifer in which the approximate base of potable water is believed to occur is named on the map, and area of occurrence in that aquifer is outlined. In general the most common anion is bicarbonate; calcium is the predominant cation, although cations are usually a mixture of calcium, magnesium, and sodium. Selected chemical analyses of water from near the base of the potable zone are tabulated. — MCM

Seewald, Ken. *See* West Texas Geological Society. 05978

Segalen, P. *See* Leon Vallejo, G. 05899

06386 **Séguin, Maurice.** Exploration pour les gisements de taconite magnétique rentables et de minerai de fer enrichi—Nouvelles methods d'interprétation de relevés magnétiques, aéroportes et au sol, dans la partie centrale de la fosse du Labrador [Exploration for economic deposits of magnetic taconite and enriched iron ore — New methods of interpretation of aeromagnetic and ground magnetic surveys in the central part of the Labrador trough (with English abs.)]: Naturaliste Canadien, v. 97, no. 5, p. 585-615, illus., table, 1970.

A new method of interpretation of magnetic surveys is based on the resolution of magnetic sources located at different levels as observed on an energy spectrum. As magnetic masses at depth depict a larger wavelength than those near the surface, most of the energy related to the regional component will be concentrated in the low frequency range and most of the energy related to the near-surface component will be found in the high frequency range. Separation of each component on the spectrum permits calculation of average depth of the corresponding source. The procedure is applied to ground and aeromagnetic surveys in the central Labrador trough; enriched iron deposits in Proterozoic metasediments are interpreted as being associated with post-Proterozoic reactivation of normal faults that show major pre-Proterozoic displacement in the Archean basement. — VMJ

Seiglie, George A. *See* Bermudez, Pedro J. 06240

06366 **Seiglie, George A.** The distribution of the foraminifers in the Yabucoa Bay, southeastern Puerto Rico and its paleoecological significance [with Spanish abs.]: Rev. Española Micropaleontología, v. 2, no. 2, p. 183-208, illus., tables, 1970.

From 30 samples of Holocene sediments in Yabucoa Bay, four foraminiferal facies were determined — fluvial-marine, bay, glauconitized-goethitized, and reef — based mainly on percentages of living benthonic foraminifers and of glauconitized and goethitized tests. Glauconite is formed between the fluvial-marine and reef facies in zones of slow organic sedimentation, under slight influence of river waters and terrigenous fine sediments; goethite is the oxidation product of glauconite. Species living only in the fluvial-marine or bay facies were not found glauconitized. Most living foraminifers in the glauconitized-goethitized facies live not in the sediments but on the living algal cover. The largest number of living foraminifers per gram occur in the reef and bay facies. Glauconitized tests are useful in interpreting the recent history of the bay and the paleoecology of similar Miocene bay sediments in Puerto Rico. — VMJ

Seitz, M. G. *See* Hoyt, H. P., Jr. 06287

Semken, Holmes A. *See* Nelson, Robert S. 06117

Senftle, F. E. *See* Thorpe, A. N. 06298

06115 **Shafiqullah, M.; Tupper, W. M.; Cole, T. J. S.** K-Ar age of the carbonatite complex, Oka, Quebec, *in* Alkaline rocks, the Monteregian Hills — Symposium, Montreal, 1969, Proc.: Canadian Mineralogist, v. 10, pt. 3, p. 541-552, illus., table, 1970.

The Cretaceous Oka carbonatite complex is intrusive into Precambrian gneisses and anorthosites. The K-Ar age, based on 28 determinations on 22 samples from 7 intrusive units, is 117 m.y.; mica, whole-rock, and nepheline K-Ar ages are 120, 125, and 127 m.y., respectively. Twelve dates on micas from 5 units fall between 102 and 120 m.y. Younger mica ages reflect later redistribution of potassium, cooling period of the magma, or both. Chronology of intrusive units could not be resolved on the basis of mica ages. Monticellite (176), melilite (155, 162), nosean (210), pyroxene (341) and apatite (1074) yield larger apparent ages because of excess argon-40. The complex or its parent magma was probably derived from the mantle and crystallized in presence of argon-40, derived from heating and fenitization of wallrocks. — *from* Authors' abstract

05832 **Shane, Lemay E.** Attenuation of acoustic logging signals: Log Analyst, v. 11, no. 6, p. 3-10, illus., 1970.

In a transmission system for acoustical logging two signals are of interest in cased holes. The casing signal is attenuated along a path from transmitter to receiver within the upper and lower mud segments, across the mud/casing interface, within and along the casing. The formation signal is attenuated along its path of interest within the mud segments, across the mud/formation interface, within the formation traversed, along the formation face, and in cased holes across casing and annulus. In a reflection system the reflected signal is attenuated along its path within the mud segment and at the wall of the hole. Factors affecting attenuation at these places are discussed and their effects on amplitudes of acoustic signals summarized. — *from* Author's abstract

06308 **Sheppard, Richard A.; Gude, Arthur J., 3d.** Calcic siliceous chabazite from the John Day Formation, Grant County, Oregon, *in* Geological Survey research 1970, Chap. D: U.S. Geol. Survey Prof. Paper 700-D, p. D176-D180, illus., tables, 1970.

A calcic, siliceous variety of chabazite makes up about 30-40 percent of an altered vitric tuff in the John Day Formation and is associated with relict siliceous glass, montmorillonite, and opal. Indices of refraction are $\tau = 1.461 \pm 0.001$ and $\epsilon = 1.465 \pm 0.001$. Hexagonal cell parameters are $a = 13.721 \pm 0.002$ A, $c = 14.795 \pm 0.004$ A, and $V = 2{,}412.4 \pm 0.8$ A^3. Chemical analysis gave a formula of $Ca_{0.45}$ $Mg_{0.04}$ $Na_{0.08}$ $K_{0.11}$ $Al_{1.16}$ $Fe^{+3}_{0.02}$ $Si_{4.82}$ O_{12} $4.57H_2O$. Chemical, optical, and X-ray data of other reported chabazites suggest two chabazite series: 'normal,' from igneous and metamorphic rocks and 'siliceous,' from silicic tuffaceous sedimentary rocks. The John Day calcic chabazite, typical of the siliceous series, is characterized by a distinctive X-ray powder diffraction pattern, relatively low indices of refraction, and relatively small cell dimensions. — *from* Authors' abstract

00010 **Sheridan, R. E.; Berman, R. M.; Corman, D. B.** Faulted limestone block dredged from Blake escarpment: Geol. Soc. America Bull., v. 82, no. 1, p. 199-205, illus., table, 1971.

An in-place limestone block dredged from the upper part of the Blake escarpment (1630 to 2000 m) has two distinct shear planes at an acute angle with well-developed slickensides. The orientation of the slickenside grooves parallel to bedding defined by miliolid foraminifera and lips on the slickenside surface indicate that strike-slip displacement, probably right-lateral, was involved in the faulting. Paleontological and outcrop depth evidence suggest a Late Cretaceous (Cenomanian-Campanian,) age for the dredged boulder. This faulting of Cretaceous strata at the Blake escarpment is believed to be associated with the Great Abaco fault, a presumed extension from transform faulting along a fracture zone of the Mid-Atlantic Ridge. — Authors' abstract

05792 **Sheridan, R. E.; Elliott, G. K.; Oostdam, B. L.** Seismic-reflection profile across Blake escarpment near Great Abaco Canyon: Am. Assoc. Petroleum Geologists Bull., v. 54, no. 11, p. 2032-2039, illus., table, 1970.

A reflection profile record across the Blake escarpment reveals the presence of a depression in a prominent reflecting horizon adjacent to the base of the escarpment. This depression, which is now buried beneath the overlying unconsolidated sediments, may be erosional in origin and may represent the ancient outer channel of Great Abaco Canyon. The drainage of this channel appears to be restricted along the base of the escarpment south of Great Abaco Canyon, with no apparent grading of the channel to a deeper level further east. It is suggested that the restriction in drainage was caused by tectonic tilting of the prominent reflector toward the escarpment when this horizon formed the sea floor. The tilting may be related to movements along a subsurface fault about 5 mi (8 km) east of the escarpment bordering Great Abaco Island, and has a strike parallel with this escarpment. — Authors' abstract

Sherwin, John R. *See* Fix, James E. 06466

06408 **Shlien, Seymour; Toksöz, M. Nafi.** A clustering model for earthquake occurrences: Seismol. Soc. America Bull., v. 60, no. 6, p. 1765-1787, illus., tables, 1970.

A statistical analysis of the time occurrence of earthquakes was performed. Except for deep earthquakes, goodness of fit tests have rejected the simple Poisson process as a model of earthquake occurrences at a very low significance level. Another parameter related to the Poisson index of dispersion is required to describe earthquake occurrences. Attempts to fit the distribution of the number of days with n earthquakes with standard two-parameter distributions were not very successful. Data were tested with respect to the generalized Poisson process. The distribution of the number of earthquakes generated in an aftershock sequence is reasonably approximated by an inverse power law distribution with exponent E being 2.5-4.0. Good fits were obtained with respect to the generalized Poisson distribution, and regional variations in E could be detected. Estimates of autocovariance function and power spectrums failed to detect definite periodicities of earthquake occurrences in the range of 2 to 256 days. Positive correlations of earthquake activity were observed for time intervals as long as 10 days. — *from* Authors' abstract

06294 **Shoemaker, E. M.; Halt, M. H.; Swann, G. A.; Schleicher, D. L.; Schaber, G. G.; Sutton, R. L.; Dahlem, D. H.; Goddard, E. N.; Waters, A. C.** Origin of the lunar regolith at Tranquillity Base, *in* Apollo 11 Lunar Sci. Conf., Houston, Tex., 1970, Proc. — V. 3, Physical properties: New York, and Oxford, England, Pergamon Press (Geochim. et Cosmochim. Acta Supp. 1), p. 2399-2412, illus., 1970.

The regolith at Tranquillity Base is a layer of fragmental debris that ranges in thickness from about 3 to 6 m. The thickness of the regolith and the exposure histories of its constituent fragments can be related, by means of a relatively simple model, to the observed crater distribution. About 5 per cent of the material composing the regolith at Tranquillity Base is expected to have come from the highland regions of the moon. Anomalous calculated ages of the regolith material may be explained in part by contamination of the regolith with small amounts of highland material that are rich in radiogenic lead and strontium. — Authors' abstract

05787 **Short, Nicholas M.** Progressive shock metamorphism of quartzite ejecta from the Sedan nuclear explosion crater: Jour. Geology, v. 78, no. 6, p. 705-732, illus., tables, 1970.

Fragments of quartzite in alluvium were subjected to shock wave pressures of as much as 500 kb during the Sedan nuclear explosion. Quartzite ejecta display diverse shock damage effects correlative at least in part with increasing peak pressures that establish a sequence of progressive shock metamorphism. These effects include shattering of quartz grains, formation of planar discontinuities, progressive breakdown of crystal structure and selective phase transformations. Most shock effects produced by meteorite impact in quartzose rocks are duplicated in the quartzites subjected to the Sedan explosion. — JCR

Short, Nicholas M. *See* Hartung, Jack B. 06393

Sieffermann, G. *See* Colmet-Daage, F. 05900

Siemers, Charles T. *See* Dodd, J. Robert. 00029

06120 **Siemes, Heinrich.** Experimental deformation of galena ores [with German abs.], *in* Experimental and natural rock deformation — Internat. Symposium, Darmstadt, Germany, 1969, Proc. (P. Paulitsch, editor): Berlin and Heidelberg, Germany, Springer-Verlag, p. 165-208, illus., tables, 1970.

Experimental deformation of galena [from Bellevue and Kellogg, Idaho, and Bonne Terre, Mo.] by axial compression and under confining pressures between 1 and 5000 bars led to the following results: Galena is brittle up to about 200 bars, and failure occurs by extension and shear fracture; under higher pressures it deforms by ductile faulting; and above 300-400 bars it deforms by uniform flow and is ductile. Stress-strain curves show that strength of galena increases with increasing confining pressure up to 3000 bars; above 3000 bars strength decreases. Under axial compression the [110] axis becomes alined with the axis of compression. A theoretical derivation of the end position is illustrated after the Taylor method, which shows that [111] cannot be an end position. Comparison of stress-strain curves for galena with those of different rocks showed that the strength of rocks is higher. — *from* Author's abstract

Siemiatkowska, K. *See* Card, K. D. 06420

Siemiatkowska, K. *See* Card, K. D. 06421

Siemiatkowska, K. *See* Card, K. D. 06422

00001 **Silver, Eli A.** Transitional tectonics and late Cenozoic structure of the continental margin off northernmost California: Geol. Soc. America Bull., v. 82, no. 1, p. 1-22, illus., table, 1971.

The continental margin north of the Cape Mendocino triple junction is a region of tectonic transition between structures related to underthrusting on the continental slope and those related to right-lateral strike-slip along the coast. Folds and faults mapped by reflection profiling on the continental slope are parallel to it, and the faults have dip separations predominantly with west side down. These structures are best explained as resulting from oblique underthrusting, with structural trends controlled by the slope direction. Northwest-trending faults occur along the coast and reported earthquake mechanism solutions show right-lateral first motions. These faults and related folds parallel the San Andreas fault system which lies to the south, most probably sharing its origin — that of shear interaction between the Pacific and North American lithospheric plates. — *from* Author's abstract

Silver, Leon T. *See* Anderson, Thomas H. 06045

Simmons, Gene. *See* Horai, Ki-iti. 06285

Simmons, Gene. *See* Kanamori, Hiroo. 06288

Simmons, Gene. *See* Chung, D. H. 06350

05938 **Simons, P. Y.; Dachille, Frank.** Possible topotaxy in the TiO_2 system: Am. Mineralogist, v. 55, nos. 3-4, p. 403-415, illus., tables, 1970.

Possible topotactic reaction mechanisms for the brookite to TiO_2 II, anatase to TiO_2 II and rutile to TiO_2 II reactions are proposed. These mechanisms are based on maintaining the integrity of the "close packed" layers of oxygen in each phase, and are consistent with known topotaxy in the TiO_2 system. Also, observations made during a *p*-T study of these reactions may be explained by the proposed topotactic mechanisms. — Authors' abstract

Simpson, Thomas A. *See* LaMoreaux, Philip E. 06226

Sims, P. K. *See* Gable, D. J. 05858

06295 **Sippel, Robert F.; Spencer, Alexander B.** Luminescence petrography and properties of lunar crystalline rocks and breccias, *in* Apollo 11 Lunar Sci. Conf., Houston, Tex., 1970, Proc. — V. 3, Physical properties: New York, and Oxford, England, Pergamon Press (Geochim. et Cosmochim. Acta Supp. 1), p. 2413-2426, illus., table, 1970.

Calcic plagioclase is the dominant luminescent mineral in lunar crystalline rocks and breccias. The blue and green bands (4,500 and 5,590 A) are commonly found in terrestrial plagioclase spectrums, but the red-infrared band at about 7,300 A found in almost all terrestrial specimens is absent. Shock metamorphism in the breccias is reflected by systematic changes in the plagioclase spectrums. Luminescence zoning in the crystalline rocks correlates well with normal compositional zoning. Luminescent cristobalite and tridymite are found in the crystalline rocks and breccias. Two types of intergrowths of alkali feldspar with silica phases were also found in the breccias, indicating differentiation, but of uncertain scale. There was no evidence of secondary aqueous mineralization. — DBV

Sirkin, Leslie A. *See* Connally, G. Gordon. 06103

06170 **Sirkin, Leslie A.; Owens, James P.; Minard, James P.; Rubin, Meyer.** Palynology of some Upper Quaternary peat samples from the New Jersey coastal plain, *in* Geological Survey research 1970, Chap. D: U.S. Geol. Survey Prof. Paper 700-D, p. D77-D87, illus., 1970.

Upper Quaternary peaty samples analyzed for C-14 age and pollen content give the following results: sample older than 38,000 yr, deciduous and coniferous pollen, probable deposition during Sangamon; 26,800 yr sample may correlate with Farmdale Stade; 16,700 yr sample suggests correlation with herb pollen zone; a 13,200 yr sample and lower and middle parts of another (13,680 and 12,330 yr) may correlate with subzone T3; upper part of the 12,300 yr sample indicates transition to spruce pollen zone; a 10,770 yr sample, dominated by pine and spruce pollen provides a minimum date for close of spruce pollen zone. The time transgressive nature of the pollen zones is suggested by the early age of occurrence of zones when compared with counterparts in southern New England. Youngest samples are dated at 5,100, 3,900, and 2,760 yr. B.P. Pollen spectra represent subzones C1 and C2 of the oak pollen zone. — *from* Authors' abstract

05936 **Slaughter, Maynard.** Crystal structure of stilbite: Am. Mineralogist, v. 55, nos. 3-4, p. 387-397, illus., tables, 1970.

The framework of stilbite is pseudo-orthorhombic with 10-member rings and 8-member rings forming approximately normal channels parallel to *a* and pseudo-orthorhombic *c* respectively. Eight-member rings are parallel to the *ab* plane and of two types: equant and narrow elongate. The equant rings form a channel parallel to *c* at 128° to the 10-member ring channel. Elongate and equant rings alternate to form a restricted channel parallel to pseudo-orthorhombic *c*. — *from* Author's abstract

05912 **Smith, Charles I.** Lower Cretaceous sedimentation and tectonics of the Coahuila and West Texas platforms [summ.], *in* The geologic framework of the Chihuahua tectonic belt — Symposium in honor of Ronald K. De Ford, Midland, Tex., 1970: Midland, Tex., West Texas Geol. Soc., p. 33-37, illus., 1970.

Smith, D. Masson. *See* Andrew, E. M. 05835

06162 **Smith, George I.; Ketner, Keith B.** Lateral displacement on the Garlock fault, southeastern California, suggested by offset sections of similar metasedimentary rocks, *in* Geological Survey research 1970, Chap. D: U.S. Geol. Survey Prof. Paper 700-D, p. D1-D9, illus., tables, 1970.

Similar sections of homoclinal east-dipping eugeosynclinal metasedimentary rocks on opposite sides of the Garlock fault and 30 to 40 miles apart suggest this amount of left-lateral displacement. The metasedimentary rocks on the north side belong to the Garlock Formation, in part of Permian age; the undated rocks on the south side, in Pilot Knob Valley, consist largely of chert with lesser amounts of slate, quartzite, sandstone, limestone, and stretched chert conglomerate. — Authors' abstract

Smith, James G. *See* Noble, Donald C. 06164

Smith, Juanita G. *See* Schwalb, Howard R. 06395

06177 **Smith, Thomas E.** Gold resource potential of the Denali bench gravels, Valdez Creek mining district, Alaska, *in* Geological Survey research 1970, Chap. D: U.S. Geol. Survey Prof. Paper 700-D, p. D146-D152, illus., 1970.

Recent investigations of the bench gravels near Denali, Alaska, including seismic refraction measurements, have defined a deposit of more than 35 million cubic yards of auriferous gravel. More than three-fourths square mile in area and at least 45 feet thick, it extends north and south of Valdez Creek. The sample data that are available indicate that the gravel contains from 50 cents to 2.10 dollars of gold per cubic yard (at 35 dollars per ounce) and that gold is distributed throughout the deposit. Although mining has been confined largely to rich pockets in bedrock depressions or incised channels, gold disseminated through the gravels constitutes the primary

economic potential of the district. Potential resource value at 50 cents per cubic yard is in excess of 17 million dollars. — Author's abstract

05950 **Smith, W. Campbell.** Memorial of Arthur Francis Hallimond — January 17, 1890-September 2, 1968: Am. Mineralogist, v. 55, nos. 3-4, p. 561-568, portrait, 1970.

05877 **Smith, W. D. M.** Petrophysical relationships from the Western Canada area: Log Analyst, v. 11, no. 5, p. 3-16, illus., tables, 1970.

Log analysis of some western Canada oil and gas reservoirs yielded data for establishing petrophysical relationships for the area. Solution of the Archie saturation equation shows a highly variable degree of oil (gas) zone definition for each reservoir. In clay sand or chalky limestone reservoirs water saturation calculations from logs are of limited use. Traveltime-porosity correlations suggest that sandstone traveltimes are influenced by cement type, not by depth. The acoustic traveltime log is of limited use in unconsolidated sands. Log density-porosity relationships are inconsistent in carbonates but useful in sandstones. Log-derived and theoretical matrix densities differ for some rocks. Permeability-porosity relationships are affected by depth in sandstones and controlled by pore-system type in carbonates. — *from* Author's abstract

05851

Soga, Naohiro. *See* Anderson, Orson L. 06267

Sohl, Norman F. *See* Owens, James P. 05860

06109 **Sood, M. K.; Platt, R. G.; Edgar, A. D.** Phase relations in portions of the system diopside-nepheline-kalsilite-silica and their importance in the genesis of alkaline rocks, *in* Alkaline rocks, the Monteregian Hills — Symposium, Montreal, 1969, Proc.: Canadian Mineralogist, v. 10, pt. 3, p. 380-394, illus., tables, 1970.

From phase relations in three planes, diopside-albite-sanidine (Morse 1968); diopside-nepheline-sanidine and diopside-albite-leucite, in the system diopside-nepheline-kalsilite-silica, a "quaternary" invariant point and "quaternary" minimum have been approximately located. These are very close both in composition and temperature to the reaction point and minimum in the undersaturated portion of the system nepheline-kalsilite-silica. From these relations, the crystallization paths of a large number of basic and felsic alkaline undersaturated lavas can be deduced, and the genetic connections between them discussed. — Authors' abstract

06302

Soper, N. J. *See* Dawes, Peter R. 06242

06149 **Sörensen, Henning.** Internal structures and geological setting of the three agpaitic intrusions – Khibina and Lovozero of the Kola Peninsula and Ilímaussaq, South Greenland, *in* Alkaline rocks, the Monteregian Hills — Symposium, Montreal, 1969, Proc.: Canadian Mineralogist, v. 10, pt. 3, p. 299-334, illus., tables, 1970.

Sites of three large intrusions of agpaitic nepheline syenites, Ilímaussaq, South Greenland (*ca.* 1000 m.y.) and Khibina and Lovozero, Kola Peninsula (*ca.* 300 m.y.) are determined by intersecting fault systems and discordances separating peneplaned Precambrian metamorphic complexes from overlying penecontemporaneous supracrustal rocks, including lavas. Ilímaussaq is associated with a rift zone. The three massifs represent latest stages of intrusive activity in the two alkaline provinces. The intrusions are of permitted discordant type: Khibina a ring, Lovozero and Ilímaussaq stratified; all three are composite, the individual complexes often displaying rhythmic layering. The intrusions, mineralogically, petrologically and geochemically related, may be interpreted as representatives of three stages of evolution of an agpaitic magma with Khibina representing the first stage, Ilímaussaq the second, and Lovozero the third. – *from* Author's abstract

06238

06245 **Sörensen, P. Brögger.** Field work on marble and calc-silicate rocks in the Nordre Strömfjord region, *in* Report of activities, 1969: Grönlands Geol. Undersögelse Rap. 28, p. 19-20, 1970.

Field data on calcareous rocks can be correlated with a suggested north-south metamorphic gradient in the Isortoq Complex, in the western Agto area. In the granulite facies terrane around outer Nordre Strömfjord, calcareous rocks have a marginal zone 5-20 m thick in which partly serpentinized forsterite becomes more plentiful towards the contact. Between the forsterite and country rock is a light green diopside ± scapolite rock, veined and brecciated by coarse quartzo-feldspathic material, often allanite bearing. Mineral paragenesis of the marble is indicated; in places it is pure and white, but most commonly has 10-25 percent silicate minerals. In the inner, amphibolite facies parts of the region, red garnet is found in the marble, and diopside is frequently surrounded by a zone of black amphibolite. This without garnet is found in Ataneq fjord and northwestern Agto areas, and a pink calcite ± green diopside ± purple fluorite in later formed lenses. — GDC

Soule, Courtney. *See* Desborough, George A. 06176

05851 **Southard, A. R.; Williams, J. Stewart.** Patterned ground indicates unstable landscapes: Jour. Soil and Water Conserv., v. 25, no. 5, p. 194-196, illus., 1970.

Along the eastern margin of the Great Basin in north-central Utah and southeastern Idaho, pedimentation has graded the surface of faulted Tertiary masses. Where the regolith is an unstable mixture of quartzite boulders in matrix of montmorillonitic clay, it may move by creep or saturated flow, sometimes resting on gravels of a Bonneville lakeshore. Cases are described of earth movement on low-gradient slopes of proposed development sites, where quartzitic stone stripes are conspicuous and usually subparallel. Interstripe areas appear on airphotos as strings of beads or islands. Removal of fines by slope wash or rill action has induced movement of boulders on the substratum of clay, a weathered tuffaceous material of the Salt Lake Group not readily infiltrated by spring melt waters. At summer's end, more moisture is stored under stone stripes than under adjacent islands. — GDC

Southard, John B. *See* Cacchione, David A. 06084

06302 **Soviet Correspondent.** Luna-16's cargo: Nature, v. 228, no. 5271, p. 492, illus., table, 1970.

It is reported that the Luna-16 space probe recovered a sample of lunar regolith from a point in the Sea of Fertility, some 900 km west of Tranquillity Base; its total weight was a little more than 100 g, and it represents a sample of the top 35 cm of the lunar surface. The specimen is divided into six zones of different granularity. Results of chemical analysis of the fine fraction and basalt rock fragments, which are tabulated and compared with Apollo 12 analyses, suggest that the lunar mare rocks differ somewhat in their content of individual chemical elements, and are closely related to the primitive terrestrial basalts. — DBV

Sowinski, Kenneth P. *See* Economou, Thanasis E. 06258

06238 **Spall, Henry.** Paleomagnetism of basement granites in southern Oklahoma — Final report: Oklahoma Geology Notes, v. 30, no. 6, p. 136-150, illus., tables, 1970.

The Troy and Tishomingo Granites from the Arbuckle Mts. have a natural remanent magnetization (NRM) that is not stable to thermal and alternating-field (AF) demagnetization. A 1,107-m.y. mafic dike in Troy Granite gives a paleomagnetic pole, common to thermal and AF demagnetization, in the range 121-128° W., 30-32° S. This is remote from other poles of similar age from North America; evidence from the initial NRM directions indicates that the dike was remagnetized during Cambrian. Demagnetization of 67 samples of granite and rhyolite from the Wichita Mts. yielded poles at 147° E., 13° N. (at 700 oersteds), and 164° E., 4° N. (at 500°C). These results do not wholly support previous interpretations (Spall, 1968). The possibility exists for a self-reversal process in these rocks and the North American Cambrian-field axis having ranged up to 30° N. latitude. — Author's abstract

Sparks, Dennis M. *See* Castano, John R. 06090

Sparks, G. E. *See* Likussar, W. 06349

Spencer, Alexander B. *See* Sippel, Robert F. 06295

06407 **Spencer, Derek W.; Robertson, D. E.; Turekian, K. K.; Folsom, T. R.** Trace element calibrations and profiles at the Geosecs test station in the northeast Pacific Ocean: Jour. Geophys. Research, v. 75, no. 36, p. 7688-7696, illus., tables, 1970.

Four labroatories collaborated on the trace-element analysis of sea water samples obtained on the 1969 Geosecs test cruise in the northeast Pacific Ocean. The elements determined were Dr, Cs, Rb, Co, Ni, Sc, Cu, Sb, Zn, Fe, and U. Two or more laboratories reported on Sr, Cs, Zn, Fe, and U. The general agreement was good. Depth variations were noted for some elements. Acidified samples were higher in Fe, Zn, and Co than the unacidified samples. Except for surface iron values, filtering had no effect on concentration. — Authors' abstract

05956 **Spencer, Edgar Winston.** Memorial to Marcellus H. Stow — May 19, 1902-November 27, 1957: Am. Mineralogist, v. 55, nos. 3-4, p. 603-607, portrait, 1970.

05801 **Spencer, R. S.** Evolution and geographic variation of *Neochonetes granulifer* (Owen) using multivariate analysis of variance: Jour. Paleontology, v. 44, no. 6, p. 1009-1028, illus., tables, 1970.

Twelve characters on the dorsal valve of *N. granulifer* were analyzed; the specimens were collected from 24 localities in Kansas and two in Missouri representing seven geologic units of late Desmoinesian to late Wolfcampian age. The statistical procedure successfully distinguished evolutionary changes from geographic variation; little variation was shown within any one stratigraphic unit; however, limestone assemblages were distinctly separated from shale assemblages, raising the question of whether the samples represented one continuous population or two ecologically controlled populations of the same species. — REG

Spinosa, Claude. *See* Nassichuk, W. W. 05807

05964 **Spooner, Charles M.; Fairbairn, Harold W.** Relation of radiometric age of granitic rocks near Calais, Maine, to the time of Acadian orogeny: Geol. Soc. America Bull., v. 81, no. 12, p. 3663-3670, illus., tables, 1970.

Mineral and whole-rock ages by both K-Ar and Rb-Sr methods confirm an age of about 400 m.y. for the Red Beach and associated granites near Calais, Maine. Initial Sr-87/Sr-86 is 0.712. Field relations in the area show that the Red Beach is post-early Early Devonian and pre-Late Devonian. Paleontologic-radiometric correlations elsewhere in the northern region suggest a period of intrusive activity in early-middle Early Devonian. Evidence is accumulating that this igneous episode is widespread in the northern Appalachians and is identifiable well beyond experimental error from the later more pervasive episode at 360 m.y. associated with the main phase of the Acadian orogeny. — Authors' abstract

Spooner, Charles M. *See* Chaudhuri, S. 06094

Srinivasan, R. *See* Ramachandran, G. N. 05889

05848 **Stacey, F. D.** Geomagnetism, *in* Global geophysics: New York, American Elsevier Publishing Company, p. 147-196, illus., 1970.

This section examines the nature and origin of the main magnetic field of the Earth; rock magnetism and methods of establishing the paleomagnetic field of the Earth, its reversals, evidence of polar wandering and continental drift, and magnetism of meteorites; the magnetosphere and radiation belts; and magnetic storms and their associated effects. — VSN

05976 **Stalker, A. MacS.** A probable late Pinedale terminal moraine in Castle River valley, Alberta — Reply [to discussion by W. P. Wagner and D. F. Eschman of 1969 paper]: Geol. Soc. America Bull., v. 81, no. 12, p. 3775-3777, 1970.

The paper under discussion was published *in* ibid., v. 80, p. 2115-2122, 1969; Abs. North American Geology, March 1970. For the Wagner and Eschman discussion, *see* ibid., v. 81, no. 12, p. 3773-3774, 1970.

Stanley, Daniel J. *See* Kelling, Gilbert. 05852

06129 **Stanley, Daniel J.; Kelling, Gilbert.** Interpretation of a levee-like ridge and associated features, Wilmington submarine canyon, eastern United States: Geol. Soc. America Bull., v. 81, no. 12, p. 3747-3752, illus., 1970.

The Nyckel Ridge is a marked topographic high on the western and southern margin of the Wilmington Canyon on the continental slope and rise southeast of Delaware Bay. The ridge extends continuously from the outermost shelf to the upper rise. Earlier studies suggested that this feature is a natural levee formed as a result of sediment overflow from the canyon under the influence of Coriolis force. Recent seismic reflection (Sparker) profiles now clearly demonstrate that the Nyckel Ridge is structural, not sedimentary, in origin, and is of pre-Quaternary age. — Authors' abstract

06447 **Stanley, Daniel J.** Flyschoid sedimentation on the outer Atlantic margin off northeast North America [with French abs.], *in* Flysch sedimentology in North America: Geol. Assoc. Canada Spec. Paper 7, p. 179-210, illus., 1970.

The hypothesis that the terrigenous prism on the Atlantic outer margin is flysch is supported by sedimentological evidence. In reviewing the last quarter century's spectacular, intensified, and diversified investigations of the continental shelf, slope and rise off Canada and the United States, it appears that conditions under which the outer margin sediments have been deposited are not comparable to those in effect during development of the classical Alpine flysch. Although similar in lithology of some flysch sequences, Cenozoic base-of-slope and continental-rise gravitational facies off North America are not valid examples of flysch in the strict sense. Flysch-like in facies and perhaps pre-orogenic in origin, they would be better referred to as *flyschoid sequences*. At this stage of offshore exploration, comparison between modern-deep-sea sediments and possible ancient counterparts is tenuous at best. The problem, by no means solved, awaits further study. — GDC

Stanley, J. P. *See* Davis, J. B. 06333

05806 **Stanton, Robert J., Jr.; Dodd, J. Robert.** Paleoecologic techniques — Comparison of faunal and geochemical analyses of Pliocene paleoenvironments, Kettleman Hills, California: Jour. Paleontology, v. 44, no. 6, p. 1092-1121, illus., tables, 1970.

The abundant and chemically well-preserved invertebrate macrofossils from the Pliocene-Pleistocene Etchegoin, San Joaquin, and Tulare Formations were studied, using the faunal lists of Woodring, Stewart and Richards (1940) and new collections. Faunal analysis indicates a marine climate similar to the northern part of the modern Californian molluscan province (Valentine, 1966), with average mean winter surface temperature of about 13°C. Geochemical paleotemperature analysis (Sr content of Mytilus shells) agrees closely with faunal analysis; neither indicates significant climatic trends or fluctuations. Paleosalinity analysis by faunal and oxygen isotopic methods also agree closely. Salinity decreased from normal marine during Etchegoin to predominantly fresh during Tulare deposition. Lateral variations in salinity are interpreted by comparison with modern biofacies of San Francisco Bay. — VMJ

05928 **Starkey, John.** A computer programme to construct spherical projections, *in* Experimental and natural rock deformation — Internat. Symposium, Darmstadt, Germany, 1969, Proc. (P. Paulitsch, editor): Berlin and Heidelberg, Germany, Springer-Verlag, p. 38-50, illus., table, 1970.

The Fortran IV program listing given here pertains to the Lambert Equal Area Projection (or Schmidt Net), the most commonly used spherical projection for petrofabric studies. The program can be readily modified to construct other spherical projections; it produces a projection of the reference sphere on any scale and in any orientation. — VSN

05929 **Starkey, John.** A computer programme to prepare orientation diagrams [with German abs.], *in* Experimental and natural rock deformation — Internat. Symposium, Darmstadt, Germany, 1969, Proc. (P. Paulitsch, editor): Berlin and Heidelberg, Germany, Springer-Verlag, p. 51-74, illus., tables, 1970.

In petrofabric studies orientation data are represented in spherical projection as great circle diagrams, where planes are represented by great circles; as scatter diagrams, where poles are plotted as points; or as contoured diagrams, where the distribution of poles is contoured. The term pole refers to any linear direction. The program discussed produces any or all of these types of diagrams and, furthermore, input data can pertain to poles or planes, mixed if required. It permits up to four successive rotations of data about any axes with subsequent redrawing of orientation diagrams. Rotated data can be produced as punched card output. Provision is made for inclusion of special poles and/or great circles on orientation diagrams to represent particular fabric elements. All diagrams are constructed on a Lambert Equal Area Projection, lower hemisphere. — *from* Author's abstract

00007 **Steidtmann, James R.** Origin of the Pass Peak Formation and equivalent early Eocene strata, central western Wyoming: Geol. Soc. America Bull., v. 82, no. 1, p. 159-176, illus., tables, 1971.

The Pass Peak Formation is a Tertiary basin-flank deposit exposed throughout much of the Hoback basin. Two lithofacies of the Formation are identified. A northern quartzite conglomerate-sandstone facies, possibly as thick as 3200 feet, intertongues southward with a sandstone-siltstone facies 1500 feet thick. This in turn extends southward and intertongues with the Wasatch Formation. Arkosic sandstone and conglomerate intertongues with the Pass Peak on the east. A sedimentary source to the north supplied quartzite cobbles and associated garnet-bearing sand and an igneous or metamorphic source, or both, to the northeast supplied abundant arkosic debris. The Pinyon Conglomerate to the north was the source for Pass Peak sediments and the Precambrian core of the Wind River Range to the northeast was the source for the arkosic sediments to the east. — *from* Author's abstract

Steiger, R. H. *See* Naylor, R. S. 06453

Steigmann, G. A. *See* Geake, J. E. 06277

Stein, R. B. *See* Sedam, A. C. 06441

06369 **Steiner, Dieter.** Annotated bibliography of bibliographies on photo interpretation and remote sensing: Photogrammetria, v. 26, no. 4, p. 143-161, 1970.

The bibliography contains references to actual bibliographies as well as to manuals and books with comprehensive lists of literature, dealing with all aspects of photo interpretation and remote sensing. The number of references to books, articles, and reports provided by the listed documents is about 50,000. A brief index is included. — MCM

06296 **Stephens, D. R.; Lilley, E. M.** Loading-unloading pressure-volume curves to 40 kbar for lunar crystalline rock, microbreccia and fines, *in* Apollo 11 Lunar Sci. Conf., Houston, Tex., 1970, Proc. — V. 3, Physical properties: New York, and Oxford, England, Pergamon Press (Geochim. et Cosmochim. Acta Supp. 1), p. 2427-2434, illus., tables, 1970.

Compressibilities of three lunar samples were studied to 40 kbar at room temperature. The samples were: a fine-grained vesicular crystalline rock (type A), a microbreccia (type C) and fines (type D). All samples were porous. The microbreccia and fines were quite compressible at all pressures; compressibility of the crystalline rock was somewhat less being 8.4 $mbar^{-1}$ at 1 atm and 1.5 $mbar^{-1}$ at 35 kbar. Some porosity appeared to remain in the samples at all pressures. Thus the pressure-volume data derived from these samples may be representative of porous surface and near-surface material in the vicinity of the Apollo 11 landing site but they may not be representative of lunar material at depth. — Authors' abstract

Stephens, Michael. *See* Johnson, J. G. 05811

Stephenson, A. *See* Runcorn, S. K. 06292

Stephenson, D. *See* Emeleus, C. H. 06249

Stern, T. W. *See* Goldich, S. S. 05965

Stern, T. W. *See* Lee, Donald E. 06209

06455 **Stevenson, D. L.** Trend-surface analysis of the structure of the Ste. Genevieve Limestone on the Effingham, Illinois, area: Illinois Geol. Survey Circ. 454, 12 p., illus., table, 1970.

Recent studies of oil accumulations in the Ste. Genevieve Limestone Formation in Illinois demonstrate the usefulness of fitting third-order trend surfaces to structural data and analyzing the residuals calculated by subtracting the trend surface from the structure surface. Known oil pools occur in areas having positive residual values. This type of investigation, supplemented by conventional structural and stratigraphic studies, was performed on a 9-township area in Effingham and Shelby Counties. Known oil pools in oolite and sandstone lenses of the Ste. Genevieve Formation lie within positive residuals. A map of areas where anticlinal noses, sandstone lenses and positive residuals are close to each other is included to indicate potential places for future oil exploration. — *from* Author's abstract

06314 **Stewart, David M.** The rock and bong techniques of measuring water levels in wells: Ground Water, v. 8, no. 6, p. 14-18, illus., tables, 1970.

Measurement of the depth to water in wells can be accomplished by timing the fall of a marble or BB. Depth to water can also be determined in terms of the frequency of the reverberations heard in a well. These two methods are called the rock and the bong techniques, respectively. Their theoretical basis, their proper execution, and their usefulness are discussed. — Author's abstract

Stonehouse, H. B. *See* Ellis, J. G. 06451

05918 **Strain, William S.** Late Cenozoic bolson integration in the Chihuahua tectonic belt [summ.], *in* The geologic framework of the Chihuahua tectonic belt — Symposium in honor of Ronald K. De Ford, Midland, Tex., 1970: Midland, Tex., West Texas Geol. Soc., p. 56-59, 1970.

06297 **Strangway, D. W.; Larson, E. E.; Pearce, G. W.** Magnetic studies of lunar samples — breccia and fines, *in* Apollo 11 Lunar Sci. Conf., Houston, Tex., 1970, Proc. — V. 3, Physical properties: New York, and Oxford, England, Pergamon Press (Geochim. et Cosmochim. Acta Supp. 1), p. 2435-2451, illus., table, 1970.

Lunar breccia 10023-2 has strong and fairly stable remanent magnetization comparable to that of many terrestrial basalts, which laboratory tests suggest was not acquired by exposure to geomagnetic fields; therefore, it was probably acquired in an ancient lunar magnetic field. The magnetic properties of lunar fines sample 10084-90 allow positive identification of almost pure iron, iron with 5-7 percent nickel, and iron with about 30 percent nickel; the first of these is of igneous, and the other two of meteoritic origin. Only 2 to 3 percent of the lunar fines are of extralunar origin. The ilmenite and ulvospinel present are essentially pure, confirming the lack of oxidizing conditions during volcanic activity. Troilite appears to be stoichiometric. At low temperatures antiferromagnetic effects due to pyroxene and paramagnetic effects due to iron in glass phases are found. — DBV

Sullivan, S. *See* Thorpe, A. N. 06298

Sun, S. S. *See* Hoyt, H. P., Jr. 06287

Sundeen, Dan. *See* West Texas Geological Society. 05978

05844 **Sutton, Graham.** (editor). Global geophysics: New York, American Elsevier Publishing Company, 199 p., illus., table, 1970.

The term "global geophysics" as used here denotes the study of the solid Earth as a whole. The text is planned as a bridge between condensed articles of scientific encyclopedias and the detailed expositions of professional texts. Following a prologue by R. H. Tucker on the Earth in space, three separate sections are devoted to geodesy, seismology, and geomagnetism by A. H. Cook, H. M. Iyer, and F. D. Stacey, respectively. The sections are cited separately. — VSN

Sutton, R. L. *See* Shoemaker, E. M. 06294

05987 **Svensson, Harald.** Remote sensing — U.S. Air Force Cambridge Research Labs. Translation 79 (AFCRL-70-0277): Springfield, Va., Natl. Tech. Inf. Service, 16 p., illus., 1970; originally published in Swedish, 1969.

Parts of the electromagnetic spectrum are discussed with type(s) of sensor(s) required to record energy in each part; classes of airborne (and satellite) remote sensor data available to geoscientists are reviewed. Different types of remote sensor data are described and examples provided: panchromatic, infrared, color, and color infrared aerial photography (Sweden); multispectral aerial photography; airborne thermal infrared imagery (Sweden, and Surtsey, Iceland); side-looking airborne radar (Oklahoma); and radio sounding of glacial ice (Antarctica). The projected future increase in amount of remote sensor data will require computer processing techniques, although man will serve the most important role in analysis and use of remote-sensor information of the Earth's surface. — *from* Author's abstract

Swann, G. A. *See* Shoemaker, E. M. 06294

Syono, Y. *See* Nagata, T. 06352

Tabuchi, Hiroyoshi. *See* Honjo, Susumu. 06371

06400 **Takahashi, Taro.** (and others). A carbonate chemistry profile at the 1969 Geosecs intercalibration station in the eastern Pacific Ocean: Jour. Geophys. Research, v. 75, no. 36, p. 7648-7666, illus., tables, 1970.

Four carbonate chemistry parameters and temperature and salinity were measured for samples collected at the Geosecs intercalibration station. Alkalinity values measured by the pH method agree within 1 percent, and total Co_2 values measured chromatographically agree within 2 percent with those measured by a potentiometric acid titration. A 3-5 percent difference between total CO_2 measured by chromatography and by infrared methods is attributed to biological alteration of the samples used for the infrared methods. When two of the four measured carbonate parameters were used to calculate the other two, the calculated values differed systematically from the measured. This discrepancy may be due to a 30 percent error in the second apparent dissociation constant for carbonic acid. — DBV

Tamrazyan, G. P. *See* Ovnatanov, S. T. 06139

06370 **Tanner, William F.** Pacific basin motion: Pacific Geology, v. 2, p. 1-10, 1970.

If the basic assumptions are true that tectonic stresses are generated and propagated at depth, most actual displacement in the active deeper zone is horizontal, and deeper material yields along vertical or steep 'faults,' then five principles concerning surface features follow: (1) long linear trenches indicate shear-plus-tension, (2) middle-sized basins (Gulf of Mexico) show tension alone, (3) wide thick mountains of major size (Himalayas) are compressional, (4) some long narrow mountains (Andes) are dominately tensional, and (5) a moving continental plate is lower near the rear. Deduced motions of major continental blocks are: North America, Europe, and India moving northward; Asia moving southward; Africa and South America motions not clear. These motions tend to confirm the fifth principle, and accordingly the North Pacific basin is moving ESE, where the East Pacific Rise is compressional. Heat flow data support this suggestion. — VSN

05924 **Tedrow, J. C. F.** Soils of the subarctic regions [with French abs.], *in* Ecology of the subarctic regions (Écologie des régions subarctiques) — Helsinki, Symposium, Proc.: Paris, UNESCO, p. 189-205, illus., tables, discussion, 1970.

The subarctic region stretches between the boreal forests, an arch which defines the northern limit of the conifers, and lies between the July isotherms of 10°C and 15.6°C. Most of it is covered by a superficial layer of Quaternary sediments resting on permafrost. Early explorers have described a qualitative pedogenetic modification to the limit of the forest, but it has not been proved. Some well-drained zones are covered by podzolic soils, while many others are brown, yellow, or gray. Gley soils occupy vast reaches, perhaps half the subarctic regions. Swampy soils cover equally important surfaces, especially in low places. A good number of mineral soils have A and B horizons, but at depth have certain characteristics of gley soils. In the subarctic zone, pedologic phenomena extend from south to north. — *from* Author's French abstract

06137 **Teichert, Curt.** Oolite, oolith, ooid — Discussion [of "Reynolds oolite of southern Arkansas," by R. H. Akin, Jr., and R. W. Graves, Jr., 1969]: Am. Assoc. Petroleum Geologists Bull., v. 54, no. 9, p. 1748-1749, 1970.

Akin and Graves (v. 53, no. 9, p. 1909-1922, 1969; Abs. North American Geology, March 1970) use the term "oolite" for rock and component particles. A review of the history of the terms "oolite," "oolith" and "ooid" shows that priority of usage and simplicity indicates that ooids are the component particles of an oolite. The term oolith should be avoided, and the dieresis above the second "o" should be dropped. — SEF

Ten Brink, N. W. *See* Weidick, A. 06247

Tew, M. J. *See* Burns, Roger G. 06082

Texas University at Austin. *See* West Texas Geological Society. 05978

Thomlinson, A. G. *See* Chase, R. L. 06093

06010 **Thompson, Gary Gene.** Paleoecology of palynomorphs in the Mancos Shale, southwestern Colorado [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 12, pt. 1, p. 5561B, 1970.

05947 **Thompson, James B., Jr.** Chemical reactions in crystals — Corrections and clarification [of 1969 paper]: Am. Mineralogist, v. 55, nos. 3-4, p. 528-532, 1970.

The original paper was published, ibid., v. 54, nos. 3-4, p. 341-375, 1969; Abs. North American Geology, January 1970.

05802 **Thompson, Thomas L.** Lower Pennsylvanian conodonts from McDonald County, Missouri: Jour. Paleontology, v. 44, no. 6, p. 1041-1048, illus., tables, 1970.

Arenaceous limestone strata below a coal bed at Coal Mine Hill in southwestern Missouri, previously considered Late Mississippian in age, are correlated with the early Morrowan Prairie Grove Member of the Hale Formation in Washington County, Arkansas, on the basis of the described conodont fauna, dominated by *Idiognathoides noduliferus*. A limestone unit above the coal bed at Coal Mine Hill contains a conodont fauna entirely of *Idiognathodus delicatus*, which indicates a late Morrowan or younger age. — JWH

06298 **Thorpe, A. N.; Senftle, F. E.; Sullivan, S.; Alexander, C. C.** Magnetic studies of individual glass spherules from the lunar sample 10084-86-2, Apollo 11, *in* Apollo 11 Lunar Sci. Conf., Houston, Tex., 1970, Proc. — V. 3, Physical properties: New York, and Oxford, England, Pergamon Press (Geochim. et Cosmochim. Acta Supp. 1), p. 2453-2462, illus., tables, 1970.

The magnetic properties of eight glass spherules (0.02-1.5 mg) from the bulk lunar fines have been investigated. All of the specimens showed strong paramagnetism due to Fe^{2+}, and most of the specimens also showed soft and hard ferromagnetic components. The iron in the form of spheres is the source of the hard magnetic component and the amount present is calculated from the high temperatures. Essentially, the same amount of iron (less than 1 percent) can be determined by all three

methods confirming that the hard component is due to nickel-iron or iron spheres in the glass. The soft component is due to odd-shaped fragmental iron or ferromagnetic minerals. No significant superparamagnetism was observed. — Authors' abstract

00038 **Tinkler, Keith J.** Pools, riffles, and meanders — Reply [to discussion of 1970 paper by E. A. Keller]: Geol. Soc. America Bull., v. 82, no. 1, p. 281, 1971.

The paper under discussion was published in ibid., v. 81, no. 2, p. 547-552, 1970; Abs. North American Geology, July 1970. For discussion by Keller, ibid., v. 82, no. 1, p. 279-280, 1971, *see* Abs. North American Geology, this issue.

Titulaer, C. *See* Geake, J. E. 06277

06264 **Tjia, H. D.** Lunar wrinkle ridges indicative of strike-slip faulting: Geol. Soc. America Bull., v. 81, no. 10, p. 3095-3099, illus., table, 1970.

In mare regions, wrinkle ridges occur en echelon within wrinkle ranges that are oriented in recurring directions suggesting fracture control. Arrangement of ridges is dextral in wrinkle ranges that trend between north and east, and sinistral in ranges striking between south and east. Wrinkle ridges in mare material may be interpreted as: drag folds or dikes occupying tension gashes formed by strike-slip movements along faults within the underlying "highland" substratum. The consistent relations between type of en echelon arrangement of ridges and strike of associated ranges further indicate that movements along the interpreted faults on the Moon have responded either to east-west regional compressions or to meridional compressions. — *from* Author's abstract

Tocher, Don. *See* Bufe, Charles G. 06078

06031 **Todd, David Keith.** The water encyclopedia — A compendium of useful information on water resources: Port Washington, N.Y., Water Information Center, 559 p., illus., tables, 1970.

This is a reference volume containing data, facts, and statistics on climates, hydrology, surface and ground-water resources, water use and needs, and water quality. Information on water resources agencies and constants and conversion factors are included also. — VSN

Toksoz, M. Nafi. *See* Shlien, Seymour. 06408

06299 **Tolansky, S.** Interferometric examination of small glassy spherules and related objects in a 5-gram lunar dust sample, *in* Apollo 11 Lunar Sci. Conf., Houston, Tex., 1970, Proc. — V. 3, Physical properties: New York, and Oxford, England, Pergamon Press (Geochim. et Cosmochim. Acta Supp. 1), p. 2463-2466, illus., 1970.

Over two hundred spherules and cylinders were extracted from the lunar dust sample. Sizes ranged from 0.75 to 0.03 mm, and most were shiny glassy objects, which were studied by interferometry. This study reveals very high specular reflection, frequent perfect sphericity, and clear evidence in some objects of microcracking and microchipping. Many spheres were once projectiles. Some have impacted in free flight with much smaller pieces of rocky material, which embedded in the surface. It is conjectured that the glassy spherules originated as a gas-blown shower from a pool of molten glass. — Author's abstract

06033 **Tolkunov, A. Ye.** Sovetskiye geologi na Kube [Soviet geologists in Cuba]: Akad. Nauk SSSR Vestnik 1970, no. 5, p. 90-95, illus., 1970.

This article reviews research performed by Russian and Cuban geologists from 1965 to 1969. A map of the regolith and associated mineral deposits was compiled at a scale of 1:1,000,000. Deposits of nickeliferous laterites formed on Eocene sedimentary rocks in Oriente Province were studied. Compilation of a geologic map at 1:4,800 of the Matahambre copper region and studies of copper mineralization in Las Villas and Oriente Provinces provided data on the history of volcanism and intru-

sive magmatism and on potential deposits. Continental Quaternary alluvium deposits were studied on connection with compilation of a map at 1:250,000. Research on the stratigraphy of marine terraces in Oriente Province revealed five levels ranging from Pliocene to Holocene in age. — EH

Trace, R. D. *See* Connor, J. J. 06165

Tsai, Y. B. *See* Aki, K. 06039

Tsay, Fun-Dow. *See* Manatt, Stanley L. 06290

Tucker, Brian. *See* Brune, James. 06076

05845 **Tucker, R. H.** Prologue — The Earth in space, *in* Global geophysics: New York, American Elsevier Publishing Company, p. 1-23, illus., 1970.

This prologue discusses the Solar System, the spinning planet (rotation of the Earth), and the moving planet (revolution of the Earth) as an introduction to other geophysical aspects of the Earth discussed in the three main sections of this book. — VSN

Tupper, W. M. *See* Shafiqullah, M. 06115

06261 **Turcotte, D. L.; Oxburgh, E. R.** Lunar convection: Jour. Geophys. Research, v. 75, no. 32, p. 6549-6552, illus., 1970.

It has been shown that, if the mean rate of lunar radioactive heat generation is similar to the terrestrial value, and if the Moon is relatively undifferentiated, solid-state thermal convection can be expected within the Moon. Because of the larger surface-to-volume ratio on the Moon, the cold and rigid outer shell is considerably thicker than on Earth; as a result, fragmentation of the shell has not occurred, explaining the lack of lunar seismic activity. Pressure release during convection could produce basaltic magmas consistent with the composition of rocks returned by Apollo 11. An approximate analysis of lunar convection indicates that convection velocities within the Moon may be large. In this case complete differentiation may have occurred early in the history of the Moon; however, there is presently no way to estimate the rate of differentiation so it is not possible to conclude whether convection and differentiation are continuing on the Moon. — Authors' abstract

Turekian, K. K. *See* Spencer, Derek W. 06407

06011 **Turk, Leland Jan.** Hydrogeology of the Bonneville Salt Flats, Utah [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 12, pt. 1, p. 5561B-5562B, 1970.

Turkevich, Anthony L. *See* Economou, Thanasis E. 06258

Turner, Brian B. *See* Bickford, M. E. 06062

Turner, F. J. *See* Paterson, M. S. 05930

05933 **Turner, Francis J.** Uniqueness versus conformity to pattern in petrogenesis: Am. Mineralogist, v. 55, nos. 3-4, p. 339-348, 1970.

Petrologic effort has been concentrated on discerning, defining, and interpreting regularly recurring patterns in igneous and metamorphic petrogenesis. In the effort to demonstrate conformity to pattern, the unique aspects of geologic processes may go undetected or be suppressed. The basaltic magma-type problem, facies series in regional metamorphism, and comparison of lunar and terrestrial rocks are cited as examples of where conformity to pattern has dominated geological thinking. — JWC

05916 **Twiss, Page C.** Cenozoic history of Rim Rock Country, trans-Pecos Texas [summ.], *in* The geologic framework of the Chihuahua tectonic belt — Symposium in honor of Ronald K. De Ford, Midland, Tex., 1970: Midland, Tex., West Texas Geol. Soc., p. 50-52, illus., 1970.

Twiss, Page C. *See* Chaudhuri, S. 06094

06462 **Unger, John D.; Decker, Robert W.** The microearthquake activity of Mt. Rainier, Washington: Seismol. Soc. America Bull., v. 60, no. 6, p. 2023-2035, illus., 1970.

A network of five high-gain portable seismographs was operated around Mt. Rainier, Washington, from July 13 to August 11, 1968, to study microearthquakes associated with this volcano. Approximately 345 microearthquakes were detected. Hypocenters and magnitudes, determined for 65 of these, were concentrated in two general regions — about 80 percent were in a roughly concentric pattern around the western side of the volcano at depths of 0.5 to 15 km, and about 8 percent were beneath the summit crater at depths of 0.2 to 20 km. About 75 percent of the microearthquakes were at depths less than 5 km. The first group may be tectonic earthquakes not related directly to volcanic processes and the second appear to be earthquakes possibly of volcanic origin. The cumulative frequency versus magnitude relation for the tectonic microearthquakes is $\log N = 5.2 - 0.82(8 - M)$. — DBV

06248 **Upton, B. G. J.** Basic rocks of the Gardar igneous province, *in* Report of activities, 1969: Grönlands Geol. Undersögelse Rap. 28, p. 26-29, 1970.

Mapping at 1:20,000 in southwestern Greenland has revealed within Precambrian basement many unmetamorphosed dolerite dikes, older or contemporaneous with such igneous complexes as Ilímaussaq and Kûngnât. One of the earliest after late Ketilidian plutonism, was the swarm of WSW-trending dolerite dikes, traceable for over 200 km. Later dikes, NE and ENE trending, are most concentrated in the Narssarssuaq-Tugutôq, Nunarssuit-Isortoq, and Ivigtut zones; their compositions, structure, and emplacement relations are compared. Data from some 50 analyses of Gardar basic rocks suggest that Gardar volcanism in south Greenland may have brought about a highly selective depletion of the upper mantle in its lowest melting constituents. High alumina contents of basalts, dolerites, and gabbros are in accord with widespread plagioclase phenocrysts in lavas and chilled intrusives, and frequent anorthositic materials. — GDC

06034 **U.S. Coast and Geodetic Survey.** (Natl. Earthquake Inf. Center). Seismicity of Alaska — NEIC 3011: Washington, D.C., U.S. Dept. Commerce, Environmental Sci. Services Adm., 1 sheet, 1970.

06035 **U.S. Coast and Geodetic Survey.** (Natl. Earthquake Inf. Center). Seismicity of the United States — NEIC 3012: Washington, D.C., U.S. Dept. Commerce, Environmental Sci. Services Adm., 1 sheet, 1970.

06036 **U.S. Coast and Geodetic Survey.** (Natl. Earthquake Inf. Center). Seismicity of Middle America — NEIC 3013: Washington, D.C., U.S. Dept. Commerce, Environmental Sci. Services Adm., 1 sheet, 1970.

06037 **U.S. Coast and Geodetic Survey.** (Natl. Earthquake Inf. Center). World seismicity 1961-1969 — NEIC 3005: Washington, D.C., U.S. Dept. Commerce, Environmental Sci. Services Adm., 1 sheet, 1970.

06161 **U.S. Geological Survey.** Geological Survey research 1970, Chap. D: U.S. Geol. Survey Prof. Paper 700-D, p. D1-D317, illus., tables, 1970.

This collection of 45 short research papers is the third published summary of U.S. Geological Survey research for 1970. Papers cover: structural geology, stratigraphy, paleontology, paleogeomorphology, geochronology, geochemistry, geophysics, economic geology, mineralogy and petrology, analytical methods, instruments and techniques, astrogeology, surface and ground water and their relations, geochemistry of water, salt-water intrusion, waste disposal, and topographic study. Pertinent papers are cited separately. — MCM

06450 **Valentine, J. W.; Moores, E. M.** Plate-tectonic regulation of faunal diversity and sea level — A model: Nature, v. 228, no. 5272, p. 657-659, illus., 1970.

It is shown how the diversity of marine fauna and fluctuations of sea level can be related to patterns of continental fragmentation and reassembly within the plate tectonics concept. In the proposed model, assembly of continents should be accompanied by regressions, and fragmentation by transgressions. The effects would reinforce the effects of ecological regulators of density — widespread transgressions would tend to moderate seasonal climates, widespread regressions to enhance continentality; species-area effects of expanding and shrinking of epicontinental seas would also be of some significance. — DBV

06214 **Valiquette, Guy; Archambault, Ginette.** Les gabbros et syénites du complexe de Brome [The gabbros and the syenites of the Brome Complex (with English abs.)], *in* Alkaline rocks, the Monteregian Hills — Symposium, Montreal, 1969, Proc.: Canadian Mineralogist, v. 10, pt. 3, p. 485-510, illus., tables, 1970.

Brome Complex consists of alkaline igneous rocks emplaced during Early Cretaceous in Cambrian-Ordovician sedimentary rocks. Earliest intrusion was gabbro, and forms a half-circular structure characterized by concentric internal structure. Later intrusions comprise monzodiorites and a suite of alkaline syenites. Rocks emplaced outside the gabbro are quartz-bearing, while those emplaced within are largely undersaturated with silica. Mineralogy and chemistry of the gabbros outline irregularities in composition, ascribed to local influence of syenitic magma. Nepheline and biotite monzodiorites have compositions between gabbro and syenite; field relations and mineralogy point out the importance of contamination. Field and petrographic data show that intrusion proceeded from quartz- to nepheline-bearing syenites, but undersaturation processes do not explain the evolution of the syenites. — *from* Authors' abstract

vanHinte, J. E. *See* Berggren, W. A. 06160

VanHorn, Richard. *See* Arnow, Ted. 06188

VanLoenen, Richard E. *See* Lee, Donald E. 06183

00026 **VanVoast, Wayne A.** Ground water for irrigation near Lake Emily, Pope County, west-central Minnesota: U.S. Geol. Survey Water-Supply Paper 1899-J, p. J1-J28, illus., tables, 1971.

In the Lake Emily area, thickness of glacial drift ranges from about 200 to more than 400 feet; within the drift are sand and gravel aquifers, some of which can yield adequate water supplies for irrigation. Surface outwash up to 60 feet thick has saturated thicknesses of more than 40 feet and transmissivities of more than 50,000 gpd/ft locally in the northern and western parts. In places of large saturated thickness and high hydraulic conductivity, the aquifer should yield more than 600 gpm to wells. Theoretical maximum yields to wells in most of the area are more than 100 gpm. Chemically, water in buried and surficial aquifers is mainly of a calcium magnesium bicarbonate type, suitable for irrigation. Calculated and estimated sodium adsorption ratios and salinity and boron concentrations are below recommended limits. — *from* Author's abstract

Vaughan, Robert W. *See* Manatt, Stanley L. 06290

06012 **Veatch, Maurice Deyo.** Ground-water occurrence, movement and hydrochemistry within a complex stratigraphic framework, Jefferson County, Nebraska [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 12, pt. 1, p. 5562B, 1970.

06377 **Vedder, J. G.** Geologic map of the Wells Ranch and Elkhorn Hills quadrangles, San Luis Obispo and Kern Counties, California, showing juxtaposed Cenozoic rocks along the San Andreas fault: U.S. Geol. Survey Misc. Geol. Inv. Map I-585, 2 sheets, scale 1:24,000, sections, 1970.

05996 **Verma, Rameshwar Dayal.** Physical analysis of the outflow from an unconfined aquifer [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 12, pt. 1, p. 5490B, 1970.

05925 **Viereck, L. A.** Soil temperatures in river bottom stands in interior Alaska [with French abs.], *in* Ecology of the subarctic regions (Ecologie des régions subarctiques) — Helsinki, Symposium, Proc.: Paris, UNESCO, p. 223-233, illus., tables, discussion, 1970.

In four ecosystems representing a plant succession sequence on the floodplain of the Chena River, Alaska, soil froze earliest and deepest in early succession stages, a felt-leaf willow stand and a 50-year-old balsam poplar stand; and later and less deep in later stages, a 120-year-old white spruce stand and a 220-year-old white spruce-black spruce stand. Large differences in time of thawing occurred between stands. In the earliest stage, thawing was completed by the end of May, whereas in the oldest stand, thawing did not begin until the end of May and was never completed, a continuous frozen layer being present between 55 and 80 cm. — ESL

Virgo, David. *See* Hafner, Stefan S. 06282

00009 **Vita-Finzi, Claudio.** Heredity and environment in clastic sediments, silt/clay depletion: Geol. Soc. America Bull., v. 82, no. 1, p. 187-190, illus., 1971.

The mechanical composition of clastic deposits is usually compared either with an ideal statistical distribution or with the postulated end product of a particular depositional environment. It would seem preferable to employ the parent material as the standard of comparison, since it determines the range of grain sizes potentially accessible to its daughter deposits. This approach is practicable in the Mediterranean area and Iran, where many valleys contain two alluvial fills of which the younger consists largely of material derived from the older. Relative silt/clay depletion of the younger fill suggests that, although the parent deposit was laid down by intermittent floods, the second phase of aggradation was characterized by sustained flow during which suspended load could leave the basin preferentially. — Author's abstract

Vlisidis, Angelina C. *See* Erd, Richard C. 05934

Volz, Gary. *See* Mooney, Harold M. 05876

05975 **Wagner, W. Philip; Eschman, Donald F.** A probable late Pinedale terminal moraine in Castle River valley, Alberta — Discussion [of paper by A. M. Stalker, 1969]: Geol. Soc. America Bull., v. 81, no. 12, p. 3773-3774, illus., 1970.

The paper under discussion was published *in* ibid., v. 80, p. 2115-2122, 1969; Abs. North American Geology, March 1970.

05788 **Waldbaum, D. R.; Robie, R. A.** An internal sample container for hydrofluoric acid solution calorimetry: Jour. Geology, v. 78, no. 6, p. 736-741, illus., 1970.

An improved container of Teflon (polytetrafluoroethylene) is an integral part of the stirrer assembly, permitting thermal equilibrium to be attained before dissolution, even for relatively coarse silicate material (> 325 mesh). This eliminates certain errors and the correction for "sensible heat." — REW

Walker, G. *See* Geake, J. E. 06277

05873 **Walker, Jack R.; Ensminger, H. Robert.** Effect of diapirism on sedimentation in Gulf of Mexico: Am. Assoc. Petroleum Geologists Bull., v. 54, no. 11, p. 2058-2069, illus., table, 1970.

In 1969 the USNS *Elisha Kane* completed an extensive geophysical survey of the Gulf of Mexico. One of the seismic systems used was the medium frequency (3,500 Hz) high-resolution seismic (reflection) profiler. This profiler, capable of producing cross sections of the first 180 feet or so of sediments below the water-sediment interface at resolutions of less than 6 feet, was particularly applicable to portrayal and study of Gulf coast diapirs. Typical structural complexities, resulting from different rates of concurrent sedimentation, erosion, water energy levels, and upward (diapiric) structural growth, are illustrated and discussed. — BHK

Walker, R. M. *See* Hoyt, H. P., Jr. 06287

05878 **Wallace, D. E.** Some limitations of seismic refraction methods in geohydrological surveys of deep alluvial basins: Ground Water, v. 8, no. 6, p. 8-13, illus., table, 1970.

Seismic methods, combined with available well and geologic data, were used to define subsurface hydrologic and geologic conditions of the Walnut Gulch Experimental Watershed, a deep alluvial basin near Tombstone, Ariz. Surface geology indicates an alluvium-filled area between the Tombstone Hills and the Dragoon Mts. Seismic surveys revealed depths to the water table ranging from zero at the confluence of Walnut Gulch and the San Pedro River to 475 feet in the central part. Seismic refraction failed to produce satisfactory results under certain conditions. The great depths of alluvium and the compaction with depth create problems. Water-table elevation may not be accurate if it is located above, and close to, a higher-velocity layer. A minimum of gravity or well-log information greatly increases reliability of seismic information in these problem cases. Still other methods may be necessary to substantiate the seismic data. — *from* Author's abstract

06032 **Walton, William C.** The world of water: New York, Taplinger Publishing Co., 318 p., illus., 1970.

The physical aspects of the oceans; ice caps and glaciers; subsurface reservoirs; lakes, swamps, and surface reservoirs; streams; and atmosphere are reviewed together with biological, economic, legal, and social aspects. Measures taken by man to develop and manage water resources and the effects of man's activities on the water environment are discussed. The problem of conservation is stressed. — VSN

06013 **Wang, Yun Fei.** Geological and geophysical studies of the Gilson Mountains and vicinity, Juab County, Utah [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 12, pt. 1, p. 5562B-5563B, 1970.

06147 **Wark, J. W.; Keller, F. J.; Feltz, H. R.** Reconnaissance of sedimentation and chemical quality of surface water in the Potomac River basin, App. H *in* Potomac River basin report, V. 4: U.S. Cong., 91st, 2d sess., House Doc. 91-343, 75 p., paged separately, illus., tables, 1970.

Results of the quality phase of this investigation (1961) were based mostly on available chemical quality data. Computed from sediment discharge measurements, made at 32 stream gaging stations during storm runoff, and streamflow records, average annual sediment discharge of principal tributaries in this basin ranges from 20 to 2,600 tons per sq mi of drainage area; that of the Potomac River is about 2.9 million tons, most of it in a relatively few days each year. Urban areas have rates about 50 times greater than do average rural areas. Particle-size analyses show suspended material mostly clay and silt; concentrations of dissolved minerals, which influence settling characteristics, decreased when streamflow increased. Probable sedimentation rates for proposed reservoirs range from 1.8 to 13 acre feet per 100 sq mi. The water is of suitable quality for most uses. — GDC

Warr, Jesse J., Jr. *See* Overstreet, William C. 06180

Warr, Jesse J., Jr. *See* Overstreet, William C. 06184

Warren, Nicholas. *See* Anderson, Orson L. 06267

Wasserburg, G. J. *See* Naylor, R. S. 06453

Waters, A. C. *See* Shoemaker, E. M. 06294

06106 **Watkinson, David H.** Experimental studies bearing on the origin of the alkalic rock-carbonatite complex and niobium mineralization at Oka, Quebec, *in* Alkaline rocks, the Monteregian Hills — Symposium, Montreal, 1969, Proc.: Canadian Mineralogist, v. 10, pt. 3, p. 350-361, illus., table, 1970.

In the join $NaAlSiO_4$-$CaCO_3$-H_2O at 1000 bars pressure, carbonate-bearing liquid coexists with a sodic aqueous vapour phase and crystalline assemblages of nepheline, melilite, hydroxyhauyne, cancrinite, and calcite. Phase assemblages and textures

from experiments are strikingly similar to those in rocks of the okaite-carbonatite series and origin by fractional crystallization of carbonated nephelinitic magma is suggested. Fenitization may result from metasomatism by a fluid analogous to the sodic vapour phase of the experiments. Studies in the system CaO-Nb_2O_5-CO_2-H_2O show that about 5 percent Nb_2O_5 is soluble in "synthetic carbonatite magma" in the absence of vapour. Thus niobium mineralization may be magmatic and not hydrothermal. — Author's abstract

Watkinson, David H. *See* Wyllie, Peter J. 06107

Watson, Kenneth. *See* Rowan, L. C. 05960

Watson, R. D. *See* Rowan, L. C. 05960

06300 **Weeks, R. A.; Kolopus, J. L.; Kline, D.; Chatelain, A.** Apollo 11 lunar material — Nuclear magnetic resonance of Al-27 and electron resonance of Fe and Mn, *in* Apollo 11 Lunar Sci. Conf., Houston, Tex., 1970, Proc. — V. 3, Physical properties: New York, and Oxford, England, Pergamon Press (Geochim. et Cosmochim. Acta Supp. 1), p. 2467-2490, illus., table, 1970.

Iron ions in a variety of chemical and magnetic states are the source of the most intense electron resonance absorption in the four lunar samples studied. It is suggested that the resonance spectrums observed in these samples are due in part to Fe^{3+} ions in a chemical and magnetic state similar to that produced in Fe_2O_3 by reduction. There is evidence of atomic disorder in the plagioclase and pyroxene fractions, which could be due to a rapid quench of the crystals from a temperature near their melting point. — DBV

Wegner, M. W. *See* Grossman, J. J. 06281

Weiblen, P. W. *See* Gable, D. J. 05858

06247 **Weidick, A.; Ten Brink, N. W.** Quaternary deposits between the Sukkertoppen ice cap and Nordre Strömfjord, *in* Report of activities, 1969: Grönlands Geol. Undersögelse Rap. 28, p. 23-25, 1970.

Ice-free land of West Greenland transected by Söndre Strömfjord, with highlands in south dropping northward to Norde Strömfjord lowlands, has permafrost polygons in coarse terrane, active ice wedges and vein nets in silt. Eolian deposits are abundant, especially near Inland Ice margin and on fluvial deposits and marine terraces in larger valleys; local are ventifacts and deflation basins. Extensive moraine has various landforms in valleys and lowlands above the marine limit, which is up to 100-110 m west of 51° W. but under 70-90 m to the east. Inland Ice, not local glaciers, apparently formed all marginal features; field data may enable their regional correlation with Holocene stages and substages; carbon dating of emerged marine terraces may relate chronology of Inland Ice positions to particular sea levels. Several marine strandlines are wave-cut terraces in reworked moraine; faulted marine deposits suggest ice-margin readvance. — GDC

Weiss, R. F. *See* Craig, H. 06399

Weist, William G., Jr. *See* Johnston, Paul M. 06146

05978 **West Texas Geological Society; Texas University at Austin; Seewald, Ken; Sundeen, Dan.** (editors). The geological framework of the Chihuahua tectonic belt — Symposium in honor of Ronald K. De Ford, Midland, Tex., 1970: Midland, Tex., West Texas Geol. Soc., 75 p., illus., 1970.

06438 **Westermann, G. E. G.** Occurrence of *Monotis subcircularis* Gabb in central Chile and the dispersal of *Monotis* (Triassic Bivalvia): Pacific Geology, v. 2, p. 35-40, illus., 1970.

The geographic distribution of *Monotis subcircularis* is extended to central Chile, lat 35° S. The early Norian *M. typica* group of E Asia and NWNorth America might have evolved in E Asia. The important late Norian *Monotis* species originated in this general area: *M. ochotica* spread from E Asia southward to New Caledonia, New Zealand and through the Nearctic southeastward into the northern Cordilleran region. *M. subcircularis* originate along the NE Pacific margin (, and NE Siberia), dispersed abundantly southward along the Andean geosyncline and also southwestward into the Indonesian sea (, and Kaukasus). The *M. salinaria* group probably dispersed from the same source area via the W Pacific and the Indonesian sea into the Tethys. Dispersion and possible migration have been typically independent of latitude. — Author's abstract

Westphal, W. B. *See* Chung, D. H. 06350

White, Amos M. *See* Overstreet, William C. 06180

White, Amos M. *See* Overstreet, William C. 06184

05983 **White, E. J.; Marchant, L. C.** Reservoir rock characteristics of the Madison Limestone in the Williston basin: Log Analyst, v. 11, no. 5, p. 17-25, illus., tables, 1970.

Porosities and water saturations from logs and core analyses for three oil reservoirs in carbonate formations in the Williston basin were compared and physical properties and fluid flow characteristics of the cores analyzed. Average sonic or resistivity log porosities are higher than core porosities, but average neutron log and core porosities are nearly equal. Average water saturations from sonic or resistivity logs are lower than core saturations. Core analysis data show increasing permeability with increasing porosity and increasing residual water saturation with decreasing permeability. Effective permeabilities to two-phase gas and oil flow are small. Porosity is chiefly associated with pore entry radii smaller than 0.5 micron. Less than half the pore volume contributes to absolute permeability of the cores. — *from* Authors' abstract

00017 **White, Sidney E.** Rock glacier studies in the Colorado Front Range, 1961 to 1968: Arctic and Alpine Research, v. 3, no. 1, p. 43-64, illus., tables, 1971.

Arapaho rock glacier conceals a relic glacier in its upvalley two-thirds. Surface motion is erratic with terminal outward spreading. Annual movement is 5 cm and discharge 215 $m^3\ yr^{-1}$. Upper Taylor rock glacier is supplied with rockfall talus from couloirs and with snow and rocks that avalanche across Taylor Glacier. Down-valley it is pitted with collapse depressions; its center moves faster than its sides; and average movement is 6.6 cm yr^{-1} and discharge is 269 $m^3\ yr^{-1}$. Fair rock glacier is fed by debris from Gannett Peak moraine and cirque headwall. Average movement is 9.7 cm yr^{-1} and discharge 771 $m^3\ yr^{-1}$. Maximum shear stress of all three glaciers near the front is 0.97 to 1.35 bar. Apparent viscosity varies from 54 to 92×10^{14} poises. C-14 dating places the Arapaho rock glacier as Arikaree stade at A.D. 950. Downvalley part of Taylor rock glacier may be Arikaree and upvalley Gannett Peak stade and recent. Fair rock glacier may be Arikaree. — *from* Author's abstract

White, William B. *See* Brucker, Roger W. 06075

Whitmarsh, Robert. *See* Berggren, W. A. 06160

06122 **Wilcox, Ronald E.** Memorial of Arie Poldervaart — July 6, 1919-October 28, 1964: Am. Mineralogist, v. 55, nos. 3-4, p. 591-593, portrait, 1970.

Wiley, M. A. *See* Muehlberger, W. R. 05906

Williams, J. Stewart. *See* Southard, A. R. 05851

Williams, T. E. *See* Powell, J. Dan. 06030

05818 **Willman, H. B.; Frye, John C.** Pleistocene stratigraphy of Illinois: Illinois Geol. Survey Bull. 94, 204 p., illus., tables, geol. maps, 1970.

The systematic classification of the near-surface rocks of Illinois, the glacial and Pleistocene deposits, is designed to meet needs of applied science and requirements for basic stratigraphic research. In keeping with the recently developed concept of multiple classification in stratigraphy, four classification schemes — rock-stratigraphic, soil-stratigraphic, morphostratigraphic, and time-stratigraphic — are presented for the Pleistocene of Illinois. Each has distinct characteristics, serves special needs, and contains units named and described for use in Illinois. Also discussed are the geologic setting of the surficial deposits and general principles of classification. Included are tabulated data on mineral composition, grain size, radiocarbon dates, details of stratigraphic succession, a glossary of formerly used terms and maps and diagrams of various units and their distribution in Illinois. — *from* Authors' abstract

05909 **Wilson, J. L.** Upper Paleozoic history of the western Diablo Platform, West Texas and south-central New Mexico [summ.], *in* The geologic framework of the Chihuahua tectonic belt — Symposium in honor of Ronald K. De Ford, Midland, Tex., 1970: Midland, Tex., West Texas Geol. Soc., p. 24-26, 1970.

05917 **Wilson, John Andrew.** Vertebrate biostratigraphy of trans Pecos Texas and northern Mexico [summ.], *in* The geologic framework of the Chihuahua tectonic belt — Symposium in honor of Ronald K. De Ford, Midland, Tex., 1970: Midland, Tex., West Texas Geol. Soc., p. 54-55, 1970.

06014 **Wingard, Norman Edward.** Economic and petrographic evaluation of gravel resources in southern Michigan [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 12, pt. 1, p. 5563B, 1970.

Wittels, M. C. *See* Hoyt, H. P., Jr. 06287

06406 **Wolgemuth, K.** Barium analyses from the first Geosecs test cruise: Jour. Geophys. Research, v. 75, no. 36, p. 7686-7687, illus., table, 1970.

A profile of barium concentration in the Pacific Ocean has been determined from the first Geosecs test station southwest of San Diego by the isotope dilution method. The shape of the profile agrees quite well with previous samples from the northeast Pacific. The absolute concentration is consistently lower than previous results. This is attributed to a combination of a blank problem and possible uptake of barium by polyethylene storage bottles. — Author's abstract

Wones, D. R. *See* Buma, Grant. 06079

Wones, David. *See* Horai, Ki-iti. 06285

06351 **Wood, John A.** Petrology of the lunar soil and geophysical implications: Jour. Geophys. Research, v. 75, no. 32, p. 6497-6513, illus., tables, 1970.

The Apollo 11 soil sample consists of particles derived from basaltic and anorthositic rock suites. The basaltic suite (95 percent of soil particles) must be representative of mare rock; anorthosites appear to derive from lunar highlands. An anorthositic crust about 10 km thick is required beneath the highlands to support their relief above the mare surfaces isostatically. To form such a crust via crustal fractionation requires that magma from initial partial melting of a substantial fraction of the Moon be collected at the lunar surface in early times. Such a layer could not be hot and molten very long; hence, young basalts must have been produced by subsequent melting at depth, attributable to internal radioactive heating. Basaltic lava, being less dense than solid basalt, is capable of rising into topographic basins (maria) already isostatically equilibrated with their higher surroundings. A lava overfilling of this type would constitute a mascon. — *from* Author's abstract

05866 **Woodward, Lee A.** Differentiation trends of spessartite dikes, Sandia Mountains, New Mexico: Jour. Geology, v. 78, no. 6, p. 741-745, illus., table, 1970.

Hornblende spessartite dikes of the Sandia Mountains, New Mexico, contain small leucocratic dikelets that appear to be differentiated from the spessartite by fractional

crystallization. During differentiation SiO_2, Al_2O_3, Na_2O, and K_2O increased; TiO_2, FeO, MnO, MgO, H_2O, and P_2O_5 decreased markedly; and Fe_2O_3 and CaO decreased slightly. Textural relations suggest unobstructed crystallization of hornblende and possibly some plagioclase in a H_2O-rich fluid of low viscosity, and late crystallization of primary epidote and chlorite. — *from* Author's abstract

05902 **Woodward, Lee A.** Time of emplacement of Pinto Diorite, Little Belt Mountains, Montana: Earth Sci. Bull., v. 3, no. 3, p. 15-26, illus., tables, 1970.

Geologic reports and maps involving the Pinto Diorite indicate considerable confusion concerning time of emplacement of the diorite in relation to other events in the Little Belt Mountains area. Both radiometric and geologic data indicate that the emplacement occurred after the last regional metamorphism, about 1920 ± 20 m.y. ago, and prior to deposition of the basal part of the Belt Series which has been dated as 1325 ± 15 m.y. K-Ar analyses by Catanzaro and Kulp (1964) suggest that the diorite was emplaced 1820 ± 40 m.y. ago. Detailed field mapping shows that emplacement occurred mainly by dilation and that the gneissoid foliation is primary flow structure developed during injection. — *from* Author's abstract

06323 **Woollard, G. P.; Daugherty, K. I.** Collection, processing, and geophysical analysis of gravity and magnetic data — Gravity gradients associated with sea-floor topography: Hawaii Inst. Geophysics [Rept.] HIG-70-19, 253 p., illus., tables, 1970.

The relation of free-air and Bouguer anomaly values to sea-floor topography is reviewed. Data for specific areas are segregated and examined on the basis of topographic forms of similar origin (continental slopes, continental border trenches, island arcs and trenches, oceanic rises and ridges). A brief introduction and a discussion of control for adjustment of gravity data are followed by eight sections: studies of the relation of surface elevation to crustal and upper mantle parameters and the isostatic mechanism; relation of gravity anomalies to sea-floor elevation in terms of tectonic associations; continental shelves and slopes; continental border trenches; island arcs and trenches; the Mid-Atlantic Ridge; the North Sea region; synthesis on oceanic gravity relation. Volume 2, under separate cover, is an appendix of principal facts for traverses and related figures. — VSN

06113 **Woussen, Gérard.** La géologie du complexe igné du Mont Royal [The geology of the Mount Royal igneous complex (with English abs.)], *in* Alkaline rocks, the Monteregian Hills — Symposium, Montreal, 1969, Proc.: Canadian Mineralogist, v. 10, pt. 3, p. 432-451, illus., tables, 1970.

Mount Royal (Montreal, Canada) is a small Cretaceous alkaline pluton 4 km^2 in area, which cuts through a sedimentary sequence of lower Paleozoic age. Mafic and ultramafic rocks (pyroxenites, hornblendites, gabbros) occupy 85 percent in area of the pluton and represent accumulated facies from an alkaline gabbro parental magma. This unit is brecciated and veined by silicic rocks (feldspathoidal monzodiorite, feldspathoidal monzonite, feldspathoidal syenites) which represent successive stages of differentiation of the magma. Thermal state of the feldspars of the silicic unit is in agreement with a shallow depth of crystallization. — Author's abstract

05887 **Wright, Anthony D.** A note on the shell structure of the triplesiacean brachiopods: Lethaia, v. 3, no. 4, p. 423-426, illus., 1970.

The superfamily Triplesiacea was placed in Orthida in "Treatise on invertebrate paleontology" (Wright, *in* Williams et al., 1965), because the shell was accepted as impunctate; however, the shell fabric was considered laminar without differentiated primary layer, as in Strophomenacea. In this study, electron micrographs of the Ordovician triplesiacean *Oxoplecia* show clear development of pseudopuncta in a species from the Ashgillian of Ireland, and a differentiated crystalline primary layer external to the laminar layer in that species and in *O. gouldi*, Bromide Formation, Okla. Presence of pseudopuncta supports association of Triplesiacea with the strophomenoid Davidsoniacea by Williams (1970), who also discovered a thin but clearly differentiated primary layer in several strophomenoids and in the orthoid *Billingsella*; billingsellaceans are presumed ancestral to both orders. — VMJ

06017 **Wright, James Arthur.** Geothermal investigations using in situ techniques [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 12, pt. 1, p. 5565B, 1970.

06142 **Wright, L. D.** Above-bottom acoustic reflections, Mississippi River delta: Am. Assoc. Petroleum Geologists Bull., v. 54, no. 11, p. 2208-2213, 1970.

Acoustic reflections from above-bottom depths are commonly observed off the passes of the Mississippi River. These reflections, previously attributed to an ooze resulting from flocculation, are apparently caused by strong salinity contrasts. — *from* Author's abstract

06107 **Wyllie, Peter J.; Watkinson, David H.** Phase equilibrium studies bearing on genetic links between alkaline and subalkaline magmas, with special reference to the limestone assimilation hypothesis, *in* Alkaline rocks, the Monteregian Hills — Symposium, Montreal, 1969, Proc.: Canadian Mineralogist, v. 10, pt. 3, p. 362-374, table, 1970.

The limestone assimilation hypothesis for forming alkaline magmas from subalkaline magmas is based on circumstantial petrological evidence. It requires (1) desilication, (2) alkali transfer by CO_2 and H_2O. Experimental results indicate that limestone assimilation causes crystallization, and that the thermal barrier between granitic and feldspathoidal liquids persists in the presence of H_2O and CO_2 to high pressures. Desilication of SiO_2-oversaturated magmas remains an unlikely process. Results in silicate-salt-volatile systems suggest that alkali transfer is only effective from liquids already enriched in alkalis. In general, experimental studies have failed to validate proposed genetic links between alkaline and subalkaline magmas through assimilation. — Authors' abstract

05952 **Yagi, Kenzo.** Memorial of Hisashi Kuno — January 7, 1910-August 6, 1969: Am. Mineralogist, v. 55, nos. 3-4, p. 573-583, portrait, 1970.

Yahner, Joseph E. *See* Persinger, Ival D. 05850

00032 **Young, Davis A.** Precambrian rocks of the Lake Hopatcong area, New Jersey: Geol. Soc. America Bull., v. 82, no. 1, p. 143-157, illus., tables, geol. map, 1971.

The area is divisible into northeast-trending fault blocks, each of which contains a mappable stratigraphic sequence of paragneisses and granitic or syenitic rocks. The paragneisses generally are well foliated; biotite-feldspar-quartz gneisses, and quartz-oligoclase leucogneiss are interpreted as metamorphosed potassium-rich sandstones and quartz keratophyres. Biotite-plagioclase gneiss is thought to be metamorphosed gabbroic anorthosite. Granitic and syenitic rocks form regionally concordant sheets viewed as syntectonic intrusives. One discordant unfoliated sheet is probably late tectonic. Mineral assemblages may be assigned to the hornblende granulite subfacies. Ca-bearing mesoperthite indicates temperatures exceeded 700°C, and garnet-sillimanite-quartz without cordierite indicates load pressure greater than 2.5 kb. — *from* Author's abstract

06331 **Young, Leonard M.** Early Ordovician sedimentary history of Marathon geosyncline, Trans-Pecos, Texas: Am. Assoc. Petroleum Geologists Bull., v. 54, no. 12, p. 2303-2316, illus., 1970.

The Lower Ordovician Marathon Formation in Trans-Pecos, Texas, consists of interbedded pelagic shale and gravity-displaced siltstone, sandstone, limestone, and conglomerate. The formation is a slope facies, derived from terrigenous and shallow-water sedimentary, igneous, and metamorphic sources, and was deposited in 30-300 m of water by turbidity currents, debris flows, slumps, and submarine landslides. The slope facies is evidence that a trough (Marathon geosyncline) was functioning as a depositional basin during Early Ordovician time. Tectonic movements along the northwest or cratonal side of the geosyncline are inferred from intraformational exotic boulder beds. Volcanism occurred prior to, and probably during, tectonic activity. — EAM

05822 **Young, Robert A.** Safe yield of aquifers — An economic reformulation: Am. Soc. Civil Engineers Proc., v. 96, paper 7719, Jour. Irrigation and Drainage Div., no. IR4, p. 377–385, 1970.

Criticisms of ambiguities in certain concepts of safe yield of ground-water reservoirs stem from prescriptive application of those concepts to allocation of ground-water resource. From the economists' theory of optimal resource allocation, ground-water basin management becomes an issue of public concern because of technical conditions in ground-water flow, and interdependence among users. In a pool of users, one who withdraws water at too fast a rate may deprive others of their water rights, lead to encroachment of poor quality water into parts of the aquifer, disrupt patterns of ground-water flow to and from streams and thereby jeopardize surface water rights, or cause compaction of aquifer particles and subsidence of ground surface. Suggested as an alternative for the safe yield rules is a net economic yield which considers the present value of social benefits minus social costs in ground-water basin management. — GDC

Yu, Y. S. *See* Coates, D. F. 06318

06207 **Zabriskie, Walter E.** Petrology and petrography of Permian carbonate rocks, Arcturus Basin, Nevada and Utah: Brigham Young Univ. Geology Studies, v. 17, pt. 2, p. 83-160, illus., 1970.

Carbonate rocks comprise most Wolfcampian and Leonardian rocks in the basin, with total thickness about 5,000 feet. Major tectonic features form boundaries of the basin, and contributed clastic materials. Petrographic analysis of samples from 10 measured sections differentiated 12 principal rock facies; water depths from 0 to 100 feet are indicated. Features resulting from subaerial leaching are fairly common. Lithofacies maps were constructed and show the configuration of the basin; its axis extends from west of Ely, northeast to the Ferguson Mtn.-Gold Hill area south of Wendover. Consistent patterns of sedimentation on the maps made reconstruction possible. Chronostratigraphic subdivisions may be made by careful petrographic work as well as by fusilinids. Withdrawal of the sea at the end of Wolfcampian time and during middle Leonardian, is recognized. — *from* Author's abstract

Zahringer, J. *See* Schaeffer, O. A. 06437

06015 **Zantop, Half.** Trace element distribution in manganese oxides and iron oxides from the San Francisco manganese deposit, Jalisco, Mexico [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 12, pt. 1, p. 5564B, 1970.

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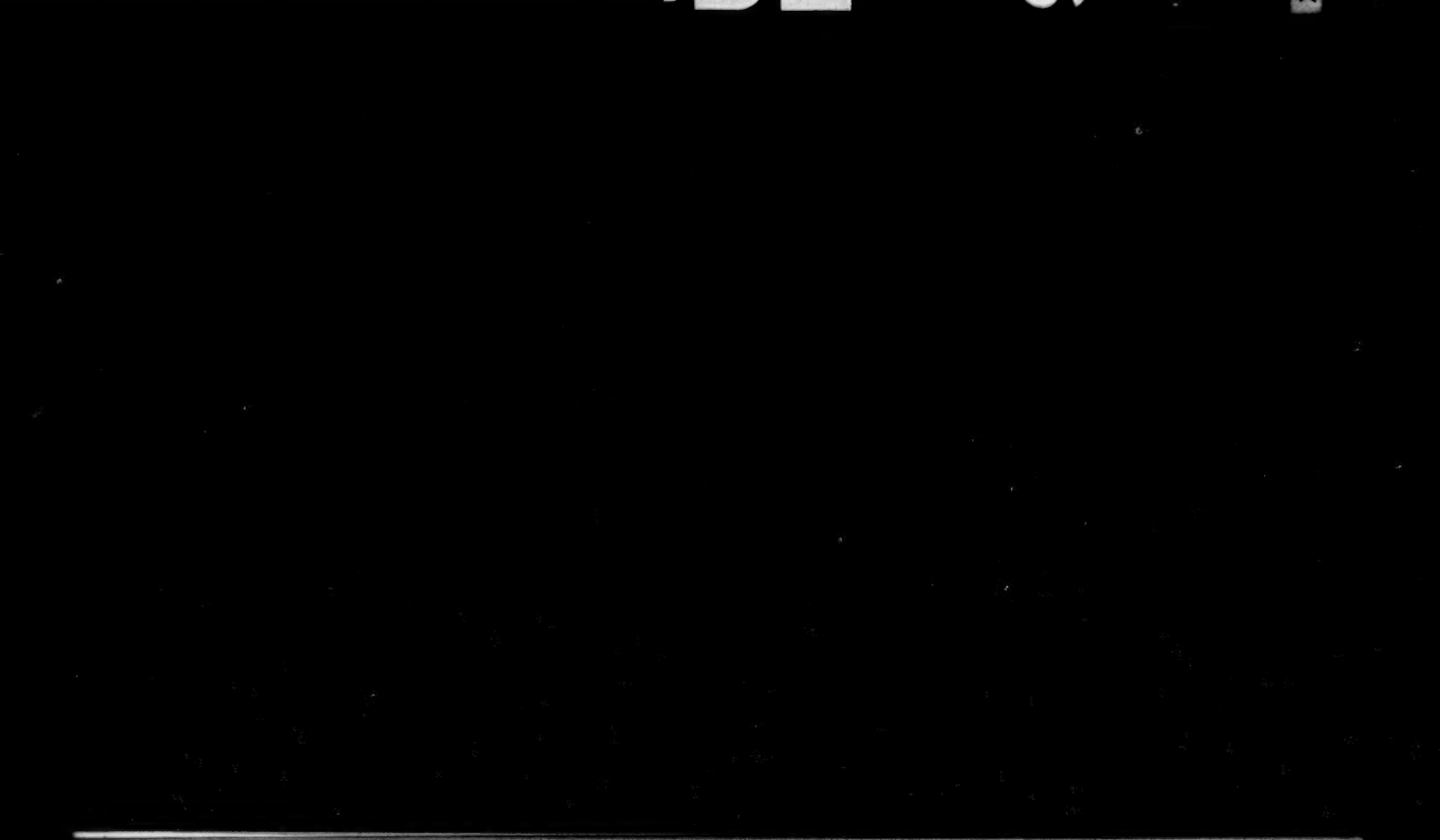
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